COLLEGE OF ENGINEERING CORNELL UNIVERSITY

the Cornell engineer

JANUARY, 1957
VOL. 22, NO. 4
25 CENTS

James R. Bachman, class of '51, speaks from experience when he says . . .

"I find the Applied Research Laboratory of U. S. Steel an interesting and rewarding place in which to work."

The rapid rise of Mr. Bachman at United States Steel's Applied Research Laboratory in Monroeville, Pa., is typical of that of many scientists and engineers who have come to U. S. Steel from college and who have staked their future with this organization.

Mr. Bachman received his B.S. Degree in 1951 and his M. S. Degree in 1952. Both of these degrees were in Ceramic Engineering. While at college, he served as a Research Assistant on a commercial research refractories problem.

In June, 1952, Mr. Bachman was employed in the Refractories Division of the Applied Research Laboratory as Assistant Technologist. During his four years of employment, he has received two promotions. Today, he is the Supervising Technologist, Refractories Division, at this laboratory.

Mr. Bachman has said: "At U. S. Steel's Applied Research Laboratory, we are actively solving problems that are of vital importance to the steel industry. These problems are many and varied, including as they do activities in the fields of physics, chemistry, mathematics, and electrical, mechanical and metallurgical engineering."

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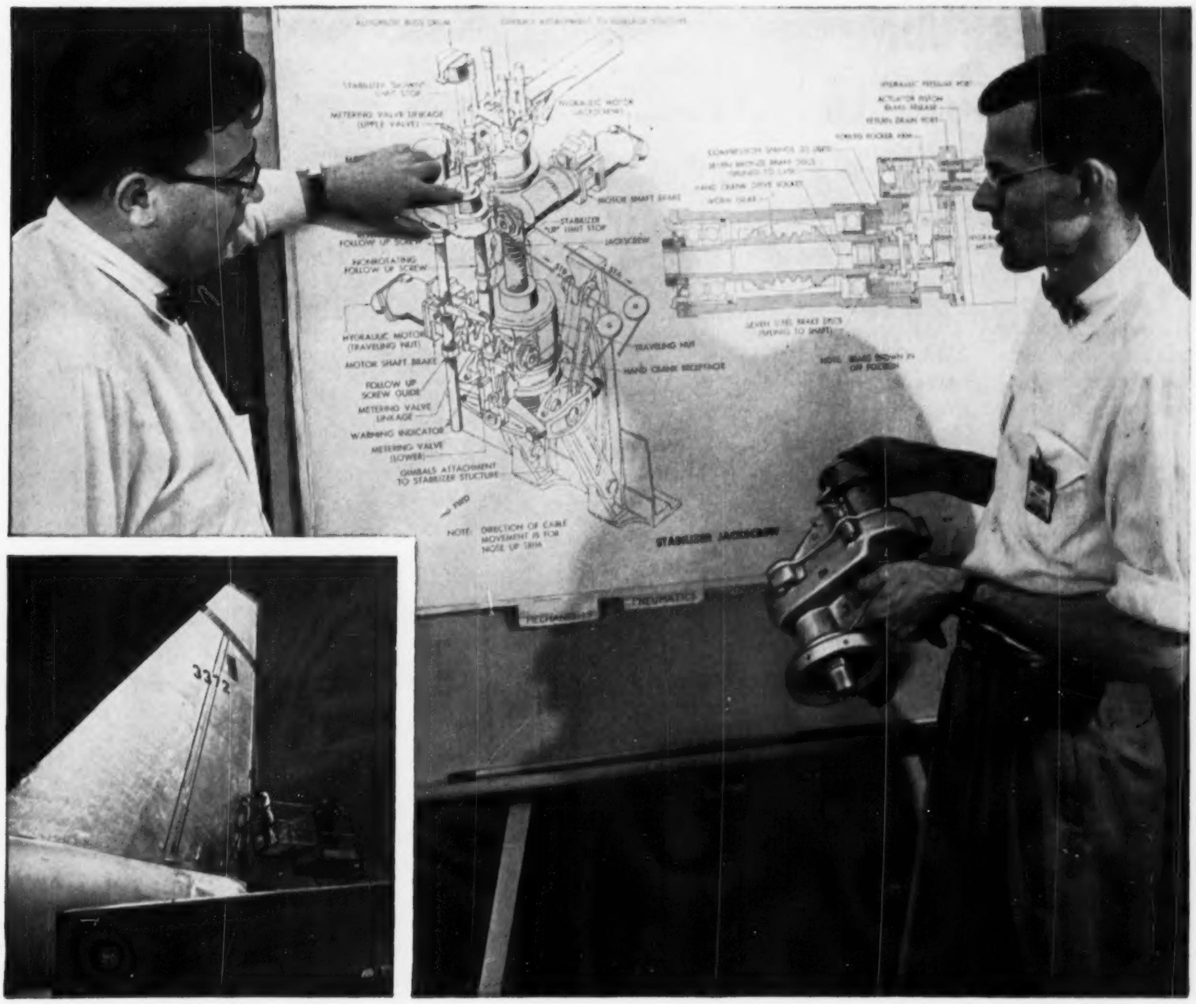

B-52 jack screw—a typical Boeing design challenge

On Boeing B-52 bombers, the horizontal tail surface has more area than the wing of a standard twin-engine airliner. Yet it can be moved in flight, up or down, to trim the aircraft.

The device that performs this function is a jack screw, which, though it weighs only 255 pounds, can exert a force of approximately 225 *tons!*

Many kinds of engineering skills went into designing and developing a jack screw so precise that it automatically compensates for stretch and compression under load. Civil, electrical, mechanical and aeronautical engineers, and mathematicians and physicists — all find challenging work on Boeing design projects for the B-52 global jet bomber, and for the 707 jet tanker-transport, the BOMARC IM-99 pilotless interceptor, and aircraft of the future.

Because of Boeing's steady expansion, there is continuing need for additional engineers. There are more than twice as many engineers with the company now as at the peak of World War II. Because Boeing is an "engineers' company," and promotes from within, these men find unusual opportunities for advancement.

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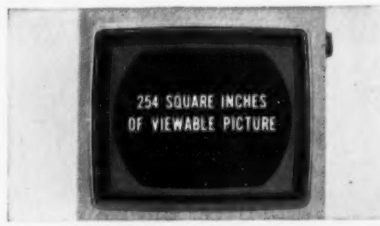

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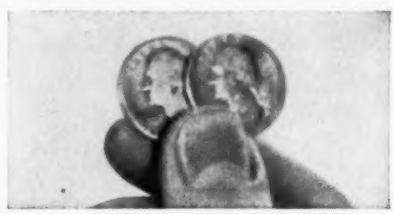

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Letters to the Editor

Editor-in-Chief
The Cornell Engineer
Lincoln Hall, Campus

Dear Madam:

I want to call attention to and to complain bitterly about the serious error that occurs in your article about me in the November issue of the Cornell Engineer. I realize, of course, that freedom of the press is one of the cornerstones of our American way of life, but I feel that every publication has a real obligation to present really important facts with meticulous accuracy and that statements that might seriously injure the reputation of any individual should be carefully verified before they are made.

The particular misstatement to which I want to call attention is that appearing on page 65 of your November issue in which you state that the speckled trout formerly mounted on the wall of my office weighed only 3¼ pounds. I wish to call your attention to the fact that this trout weighed 8¼ pounds. I am not particularly sensitive to insinuations about my lack of ability as a teacher or as an engineer or my personal peculiarities, but I certainly resent deeply any implication that I am such an inexpert fisherman that I would regard a 3¼ pound trout as worthy of preservation for posterity.

Very truly yours,
F. H. Rhodes

480 Griswold St.
Glastonbury, Conn.

Dear Editor:

I was greatly interested in Jesse S. Tarleton's article in the October issue, "Unionization of Engineers," setting forth and discussing the pros and cons of that much mooted subject. This chances to be one to which I have given much thought over a long period of years and if I were drawing the conclusions, I believe that I should take my stand firmly with the cons. My experience embraces both the construction and the manufacturing fields and I once did a report for the National Industrial Conference Board on "The Functions of Management." The primary function, I then came to the conclusion, is LEADERSHIP. Leadership not only of the capital factor but of the labor factor. And if American management had begun sooner to live up fully to its responsibility for proper handling of the human element, instead of remaining overlong subservient to the controllers of credit capital and the short sighted desires of predominant stockholding capital for larger returns, unionization of any part of the working force, let alone the technicians, would have made a great deal less progress, while in plants with the right kind of management it would have secured not even a foothold. Today, as a result of blindness—or, maybe I should better term it short-sightedness or unenlightened self-interest — of those in control of industry, and their failure very generally to discharge their duty as citizens, labor with the helping hand of government has literally gotten a stranglehold on our economy.

So I very earnestly hope that our technically trained men and women will resist the temptation to join up with any unions of the coercive type, instead lend their support to the wider prevalence of the right type of management—the logical leader of the labor as well as of the capital factor in production—and point their ambitions to attaining more and more high positions as directors of the management function, which I envision to be the best hope for a sounder economy, and better things for everybody, as time goes on.

Very truly yours,
Harry F. Porter, CE '05

Editorial . . .

"I-It" and "I-Thou"

Dr. Ralph Overman, Director of Special Studies at Oak Ridge, posed a significant problem facing science and engineering students in his lecture during the 1956 Campus Conference on Religion: Is the scientific method adequate for the whole of life experience? This problem merits careful consideration by engineering and science students during their college careers because its solution will mold their professional contribution, and influence working relationships with their fellow men. The era in which today's technical students will be industrial and scientific leaders, will present complex social and moral as well as technical problems. An awareness that scientists and engineers must contribute to society beyond the scope of the scientific approach of their professional activities should be developed by technical students as they obtain their formal education.

The scientific method, according to Dr. Overman, begins with "percepts" or the experiences the scientist or engineer perceives with his five senses. He takes experimental data from his observations and summarizes or generalizes it into laws. The scientist or engineer then extends his observations logically and mathematically in terms of "constructs" to interpret and make useful the percepts he observes. The constructs he develops may be the basis for predictions about nature that, when tested, may validate the original percept or law. The scientific method does not *prove* the existence of atoms. Rather it *validates* information that has meaning because it is useable. Nuclear bombs explode. Thus predictions validate original percepts about the atom.

The scientist or engineer objectifies the universe in terms of, in the words of Overman, "I-it relationships." He does so for further understanding and utilization of natural phenomena in order to meet man's needs. Yet the astronomer who objectively concludes that man in space and time is an infinitesimal speck, is himself a man. Dr. Overman stated that there are other legitimate valid experiences that cannot be delineated within the "I-it" context. Fear, hate, distrust, happiness, satisfaction, love are emotional experiences that are important in relation to other human beings. These are subjective, or "I-thou relationships." The scientist or engineer may attempt to devise a system of constructs to validate what he perceives in this realm. When he does so, he deals not with "I-it" but rather with "I-thou," and the two relationships are distinct. He must recognize in his work that both relationships are real and important to him, as a man whose job it is to objectify the things around him.

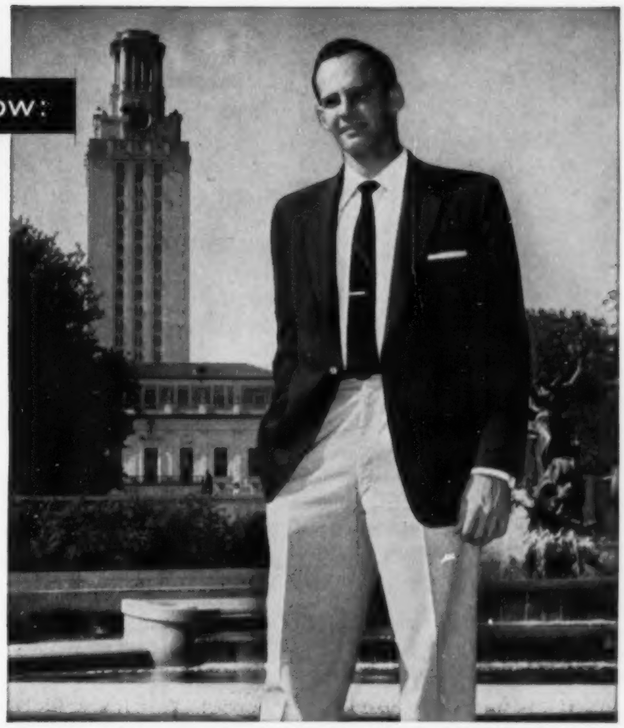
Dr. Overman asserts that there is a statement within "I-thou" relationships he experiences that relates constructs to original percepts in much the same way as scientific constructs may validate a scientific law. For him this link is Christianity because it resolves fundamental questions in "I-thou" relationships. This decision cannot be the result of objective study alone. It is subjective, based on a consciousness of a need. For Dr. Overman there is a discontinuity in intellectual processes at which emotional experience and commitment take place. The intellect is still important, but decisions may transcend intellect alone in "I-thou" relationships. Dr. Overman suggests that as wave and particle are complimentary descriptions of an electron, there must be "complimentarity" of "I-it" and "I-thou" experiences. Rather than teaching religion on Sabbath and science the rest of the week, men should seek a further unity of the two disciplines to more adequately meet the needs of life.

Christianity may not be the way for every man to resolve personal questions in his "I-thou" relationships. But Dr. Overman's focus upon the *need* to consider the answers is important to the engineering and science student. Concern and consciousness in "I-thou" experiences cannot be taught in the academic sense. We cannot be "educated" to love. But we live in a time when a need to more fully understand other men is inescapable. While we learn to objectify the universe we must develop an ability to subjectify our dealings with others and to recognize the interrelationship of our efforts. We must understand the limits as well as potentiality of the scientific method, take inventory of our own sense of values, and try to learn about the basic beliefs that motivate the actions of others. To be effective as engineers and scientists, we must be able to develop and apply valid "I-it" relationships. In addition, we must promote and practice mature "I-thou" relationships in order to find the greatest meaning in our work, and most effectively serve our fellow men.

RGB

"Van" Wolford wants to know:

How often does Du Pont transfer technical men?



Fred V. Wolford receives his B.S. in Chemical Engineering from the University of Texas in January 1957. "Van" is a member of the Southwestern Rocket Society, Canterbury Club, and local Vice-President of A. I. Ch. E. Like all students, he's interested in finding out about the best opportunities offered in his profession.

Ed Berg answers:

Edward H. Berg received his B.S. Ch. E. from Cornell in 1944 and served as an Engineering Officer on destroyer duty until 1946. Since coming with Du Pont, he has worked at New Jersey plants as a Field Supervisor in Du Pont's Engineering Service Division. Ed was recently transferred to Du Pont's Design Division to further round out his professional development.

WE'VE just completed a study on that subject, Van, so I can speak with some authority.

Using technical graduates who came with Du Pont in 1949 as a base, we found these men averaged 1.7 transfers of location in 7 years. We frequently shift men from one assignment to another at the same location, to broaden them professionally. But it's interesting to note that 38% of those surveyed had not changed their location of employment at all.

Changes of work location depend a little on the type of work a man enters. For instance, there are likely to be more transfers in production and sales, fewer in research.

But one thing is certain. Du Pont transfers are always purposeful. The majority are a natural result of Du Pont's continued growth and expansion. And they invariably represent opportunity for further professional development.

Additional employment information is given in "Chemical Engineers at Du Pont." This booklet describes in detail the work and responsibilities of chemical engineers who work at Du Pont. Write for your free copy to the Du Pont Company, 2507C Nemours Bldg., Wilmington 98, Del.

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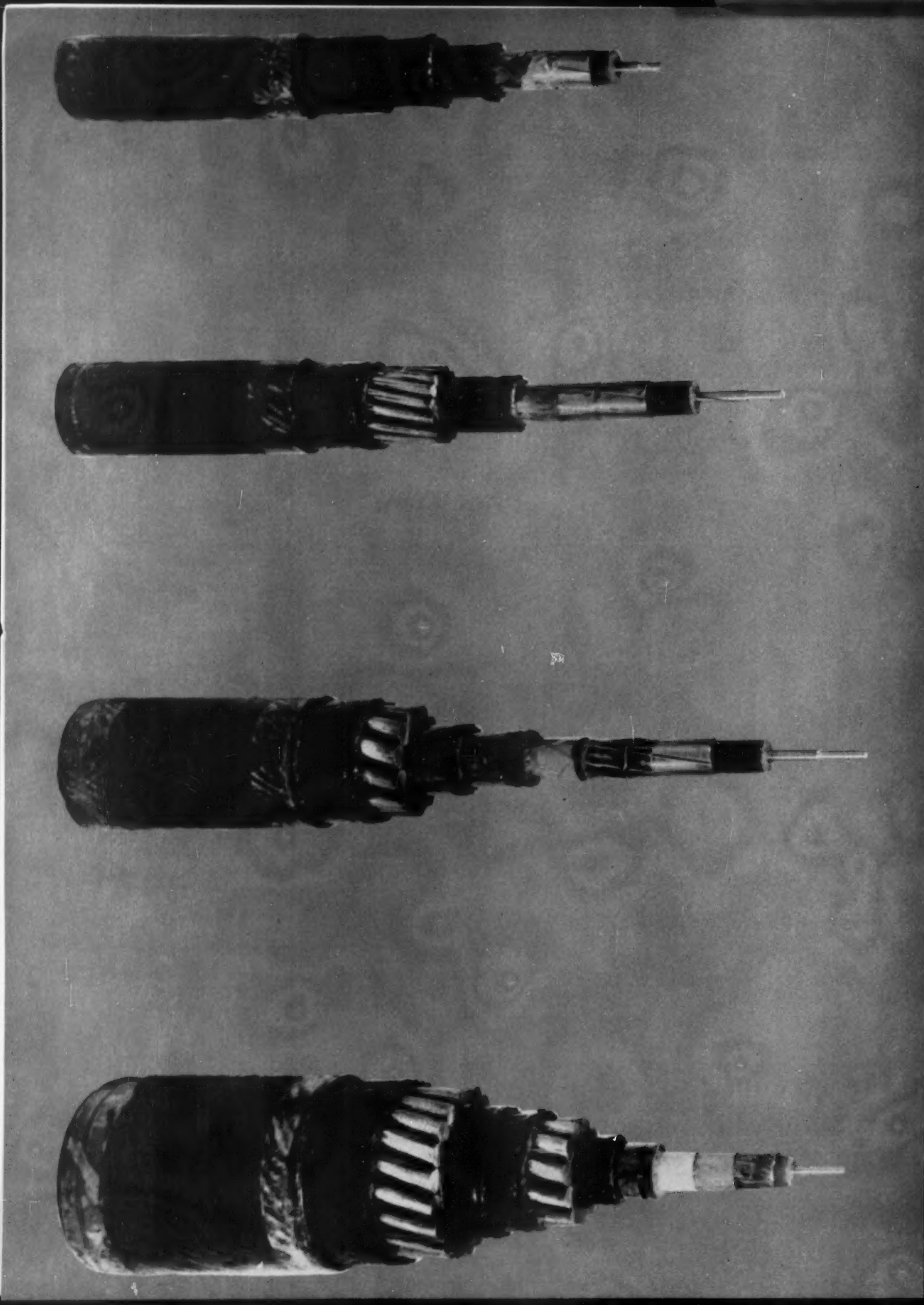


SUBMARINE CABLES

by

David Lamensdorf, EE '60

One of the most vital links of international communications today is submarine cables. These cables cross almost every major body of water in the world and enable instantaneous, reliable communication between practically any two points on the earth. The cables are used mainly by two fields of communication, telephone and telegraph. Although telephone cables have been laid extensively only since World War II, telegraph cables have been in use for over a century.

In 1842, Samuel F. B. Morse sent an electric current through an underwater cable across New York Harbor; it was the first time a current had been sent through a submarine cable of any appreciable length. Just one year later, Morse proposed laying a telegraph cable between the United States and England, a dream which took over twenty years to be realized. That same year, Samuel Colt laid down, between the Battery and Governor's Island in New York Harbor, the first actual underwater telegraph cable, but after only one day's operation, it was broken by a ship pulling its anchor. Further development continued on these short submarine cables and in 1851 the first international telegraph cable was laid, crossing the English Channel between Dover, England and Calais, France.

At this time, Cyrus Field began making plans for a transatlantic cable. In 1857, he made his first attempt, planning to have an American and a British warship each lay half of the cable and meet in the middle of the ocean. Due to its poor quality, the cable broke after only two hundred miles were laid. In 1858, he made a second try using the same method. This cable was successfully completed on August 5, and messages were immediately being sped across it. Three weeks and 400 messages later, after gradually growing weaker and weaker, the cable died, probably due to faulty insulation.

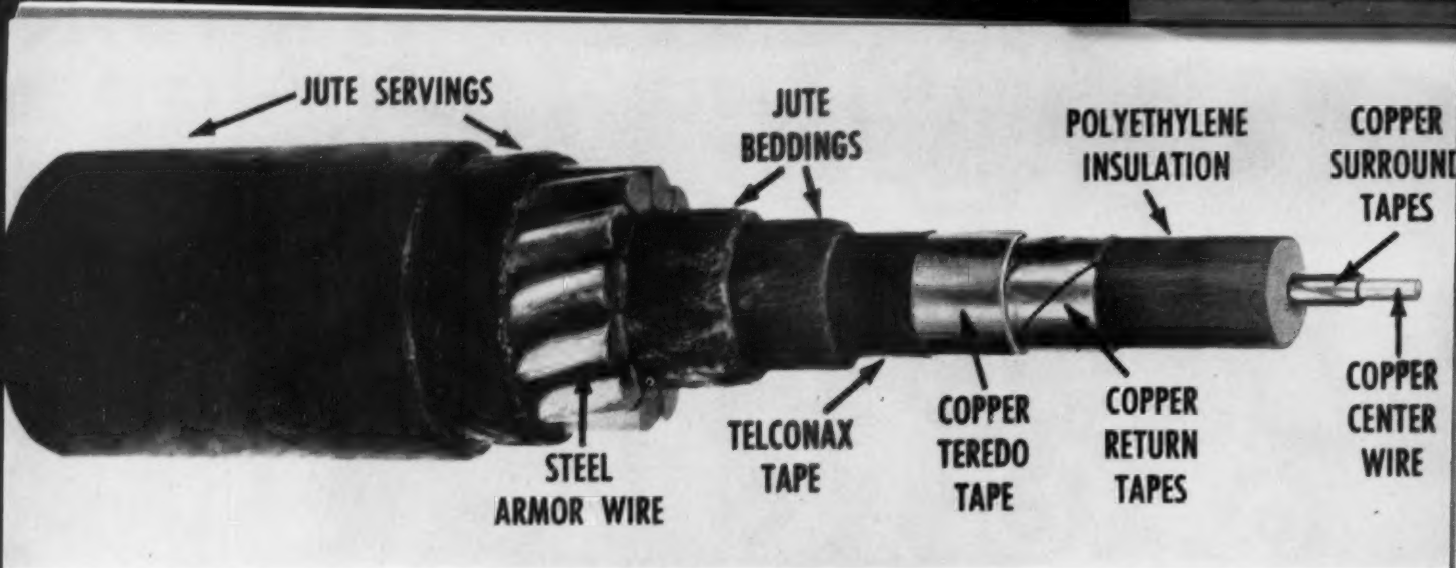
Field was persistent, though, and in 1865, he was loaned the "Great Eastern" for another attempt. The "Great Eastern" was an English steamship of such immense size that many people said it was built about forty years before its time. It was as big as many of the modern luxury liners, but its owners never seemed to be able to find a profitable use for it. In July, 1865, the big ship started out from Ireland headed toward Newfoundland, with 1395 nautical miles of cable it its holds. (One nautical mile is approximately equal to 1.15 statute miles.) About halfway across, the crew stopped laying the cable because the test signals being sent over it were failing too often. While they were reeling in the cable, it broke. A year later, Field made another try and this time he was successful. This first successful transatlantic cable was completed on July 27, 1866. Field then went back and grappled up the end of the 1865 cable, completing that one, also, to make two successful transatlantic cables.

The "Great Eastern" was subsequently used to lay many more submarine cables. In 1869, it completed the first transatlantic cable to the United States, a distance of 2584 nautical miles. Then it laid the Indian Ocean section of the London to India submarine cable. By 1874, it had laid another two transatlantic cables, one of which is still in use today, and repaired four of them in midocean.

The first Pacific cable was laid in 1902 from San Francisco to Honolulu. Two years later that cable was extended to Manila. In July, 1904, President Roosevelt sent the first message around the world by telegraph; it took eleven minutes.

Construction of cables differed little from the first cable of Cyrus Field in 1866 until 1924. That first

Frontice—Cable sections with four types of protective coverings for use in telephone cables. As a cable needs more protection in shallow water, the shore end sample at the bottom is more than 2½ inches in diameter and weighs almost 9 pounds per foot. The deep water piece at the top is about one inch in diameter and weighs only one pound per foot. The other two are used at intermediate depths.



Construction details of a submarine telephone cable.

cable was an inch in diameter and was made of seven copper wires twisted in soft rubber, then wrapped in eight layers of a rubber compound and, finally, covered by ten charcoal iron wires spun in manila yarn. In 1924, Western Union laid a cable from New York to the Azores using a single copper conductor wound in a very thin ribbon of metal called "permalloy." Each permalloy cable had the capacity of seven cables of the earlier design. These cables have been operated at speeds of 14,000 letters per minute each. This large capacity is utilized by operating the cable in several separate channels, each being an individual unit.

Problems of Cable Laying

While laying the cables, many problems have had to be overcome. Torsional stress is one of the biggest of these. The only cable thus far developed which wouldn't twist under tension is a non-armored one. Under ordinary circumstances, however, torsional balance can be achieved only by two sheaths of wires in opposite directions of lay. But, this is very expensive. The conventional design used in most cables is to have galvanized steel wires in a helical lay and to keep the angle of lay with the axis as small as possible to reduce the torsional stress. A helical sheath, though, will cause the cable to kink, if the ship stops while laying it, because the tension then decreases and the cable will become slack. The torsional twists will then fall down the cable's axis as it tends to untwist at the top. When the ship starts up again and the tension is increased, permanent kinks will occur in the cable.

Another major problem is that of elongation and contraction. While the cable is being laid, the sheathing wires tend to stretch. Accordingly, the length of the soft copper core also increases. When the tension is relaxed, the sheathing will resume its normal length, but the copper core, due to its low elastic limit, won't. It becomes wavy and will burst through the cover, protruding in a crescent called a sprew, if there is any opening between the wires of the sheath. Upon reapplication of tension, the sprew may be gripped between the adjacent wires of the sheath and squeezed, causing an electrical fault.

To remedy this, polyethylene is used as an insulator, because of its toughness. Since the conductor is composed of strands, it is weak to axial compression, so that the excess stress will build up at a weak point in the insulation. By causing all this stress to press against one of the conductor's strands, the insulation will be forced to split. The whole conductor will then rupture the insulation and knuckle in a large sprew. This can be remedied in three ways. The first is by using polyethylene of a higher molecular weight, which is less likely to rupture. The second and third are more fundamental. They are to use a solid conductor which has enough strength to resist knuckling or to give a stranded conductor greater helical angle of strand lay, making the conductor so limp that there is no danger of compressive stress developing.

Development of Repeaters

One of the great improvements in submarine cables and their operation is the use of amplifiers or repeaters for both increased capacity and speed of operation. These were first introduced by the British Post Office about fourteen years ago in a short cable. Repeaters have since been installed in many of the transatlantic telegraph cables, thereby tripling their speed and capacity. The telegraph repeater is simply a three stage vacuum tube instrument similar to the amplifier in a home radio, and is used to amplify signals which are received. It is enclosed in a cylindrical steel case, four and one half feet long, one foot in diameter, and weighing 1100 pounds. The unoccupied space in the repeater is filled with oil. If one or two rather than a series of repeaters are used in a cable, the repeater is placed on the receiving side of the ocean, not too far from the source of power or the terminal. This position is usually along the edge of the Continental Shelf; however, it

must not be near the spot where one cable may cross another, there being many such places. The repeater in such a case would pick up and amplify any signals induced from either cable. A safe distance between cables is a few hundred miles, provided the two cables are widely separated upon their approach to the crossing.

There are two basic types of repeaters—the two way repeater which will amplify signals going in both directions on the cable and the one way repeater which will amplify only signals in one direction. The one way repeater is naturally much easier to build and also to install, due to its smaller size. The two way repeater has a rigid, heavy case which won't pass through a cable ship's paying-out machinery and puts added stress on the cable during installation because of its weight. These difficulties have made the one way repeater greatly favored thus far. However, it has been figured that one transatlantic coaxial telegraph cable with many regularly spaced two way repeaters would surpass the overall capacity of all the other existing transatlantic telegraph cables.

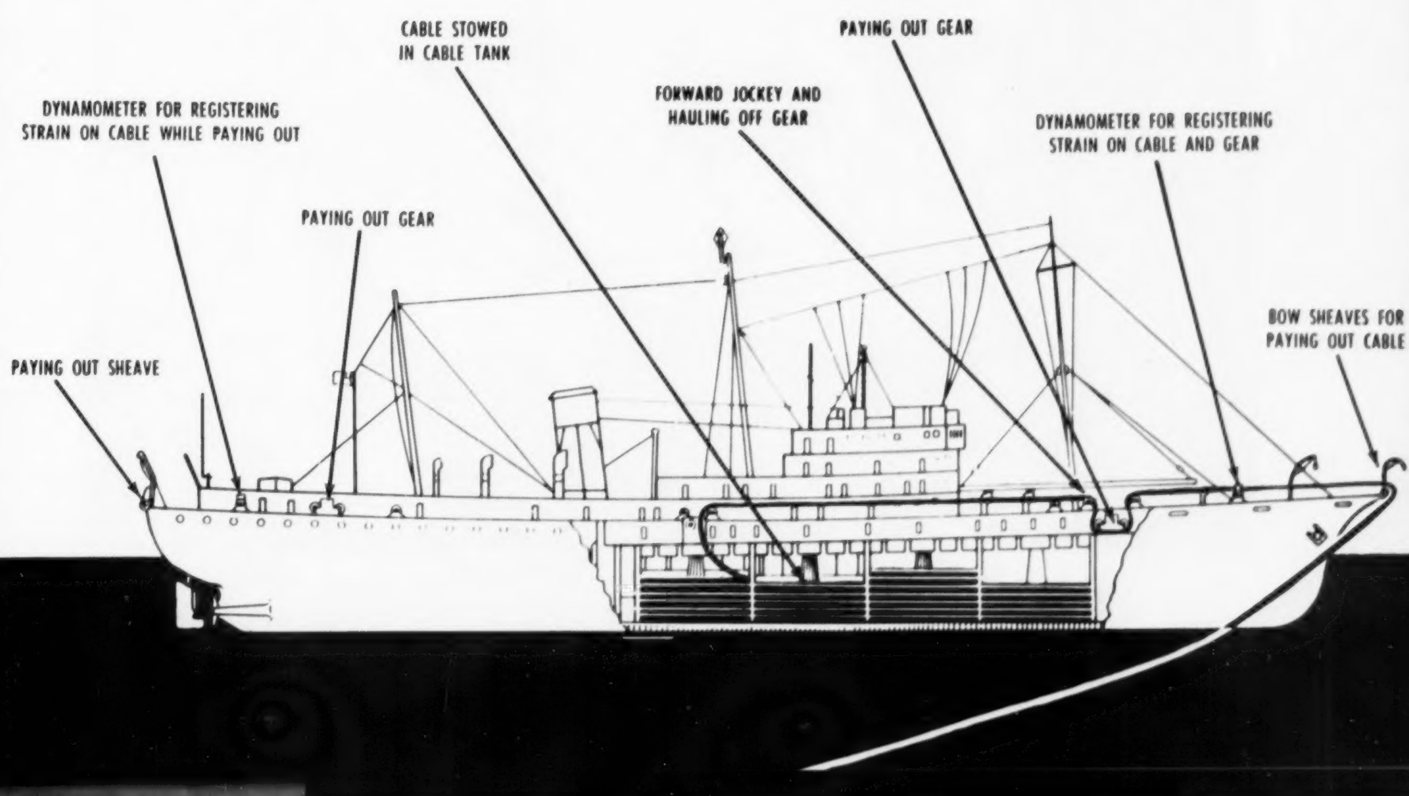
Telephone Repeaters

The development of submarine telephone cables was greatly enhanced by the introduction of repeaters. The high frequencies needed for telephone transmission had to wait for the development of ways to withstand the high terminal voltages needed and to boost the signal level at frequent intervals along the cable. The lower telegraph frequencies essentially need a terminal potential of 100 volts or less and no intermediate amplification. The English development of polyethylene in 1933 helped to solve the first of these problems and the repeater was the perfect answer to the second.

The British were the first to use repeaters in a telephone cable. American research in this field has since been concentrated on a repeater to be used in long deep sea telephone cables with ultimate aims of a transatlantic cable. The American Telephone and Telegraph Company built a one way repeater of this type which was relatively small in diameter and quite flexible so that it could fit through a cable ship's paying out machinery. The one way repeaters necessitated the use of two cables to complete every submarine telephone circuit. This repeater is quite conventional electrically. It has three electron tubes which in three stages boost incoming signals and passes them on to the next tube. Each of these repeaters amplifies the power of the incoming signal about 1,000,000 times. The unique part of the repeaters is the mechanical arrangement. It is made up of sixty components and is eight feet long and less than two inches thick. The repeater is divided into seventeen separate cylindrical, lucite cases, which are in turn surrounded by two layers of steel rings with overlapping joints to withstand the ocean's pressure. Covering it all is a copper cylinder under layers of jute and armor wire. The ends of the repeater have a system of watertight seals seven feet long. First, there is a metal to glass seal.

On the forward deck of the cable ship H.M.T.S. Monarch is the paying-out mechanism and sheaves over which shore end segments of the Atlantic telephone cable will pass. This is similar to equipment on the after deck for paying cable out in deep water.

H.M.T.S. MONARCH



Second, is a plastic seal molded to the cable's insulation. The third seal is an extension of the housing formed within the copper tube and providing a transition between the repeater and the cable. On the ocean floor, the repeater appears as a tapered bulge in the cable. The most important idea in this design is the fact that the repeater can pass through the cable ship's paying-out machinery.

The repeaters are built under the most exacting conditions possible, so that there will be no flaws. Many of the parts are made manually because machines haven't been invented yet which could do such a complex job. The repeaters are expected to last twenty years under a pressure of 6500 pounds per square inch and surrounded by sea water, which is corrosive enough to gnaw away most metals.

Telephone Cable

The telephone cable itself is also made to a high degree of accuracy in specially built factories. The conductors are tested with 90,000 to 100,000 volts to insure strength and all joints are x-rayed and put through similar high voltage tests.

Telephone cable has been developed in a few basic sizes according to the depth at which it will be laid and with slight variations according to the climate in which it is laid. The core or coaxial conductors of all these cables are the same. Varying amounts of armor account for the different sizes. The lightest and thinnest cables are used in the deepest water while the more heavily armored cable is needed near the shore. One type of cable is for shallow off-shore areas and is 1.85 inches in diameter while weighing about eleven tons per nautical mile. A second type for use in water of 200 to 600 fathoms depth is 1.43 inches thick and weighs six tons per nautical mile. A third, the deep sea size cable employed at depths of 600 to 2400 fathoms or two and one half miles, is 1.23 inches in diameter and weighs only three tons per nautical mile.

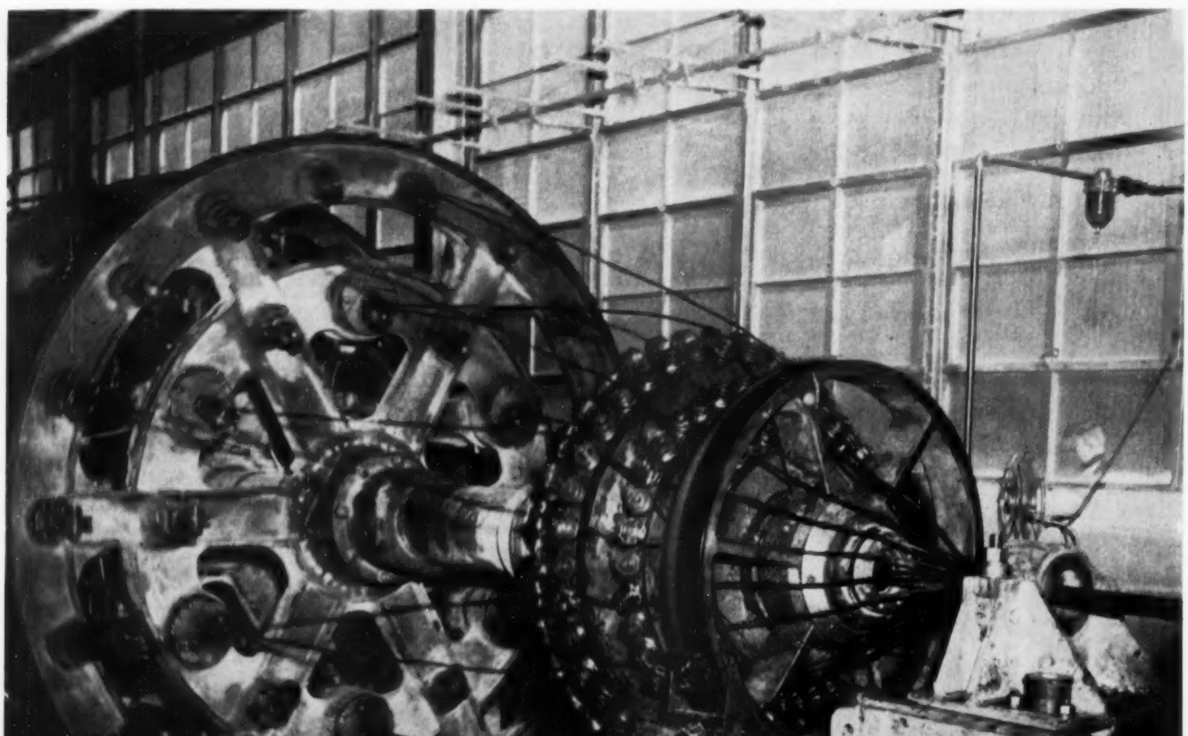
A cross section of the shallow water conductor shows at the center, a solid copper wire covered with three copper tapes. Over this is a thick layer of crack resistant polyethylene insulation. Then, to complete the circuit, there are six spiraling copper tapes as a return conductor. Another copper tape is then used to protect against the gnawing teredo worms. The next layer is an impregnated cotton tape called teleconax. Covering this are two layers of jute applied in reverse directions. Next is the armor. This is a layer of galvanized steel wire covered with a braid impregnated with an asphalt compound. Finally, there are a few layers of tar and jute as a final covering.

Since coaxial cable is used for the telephone cable, there is little chance of the center conductor being strong enough to rupture the insulation, so that the problems of laying telegraph cables are not present in telephone cables.

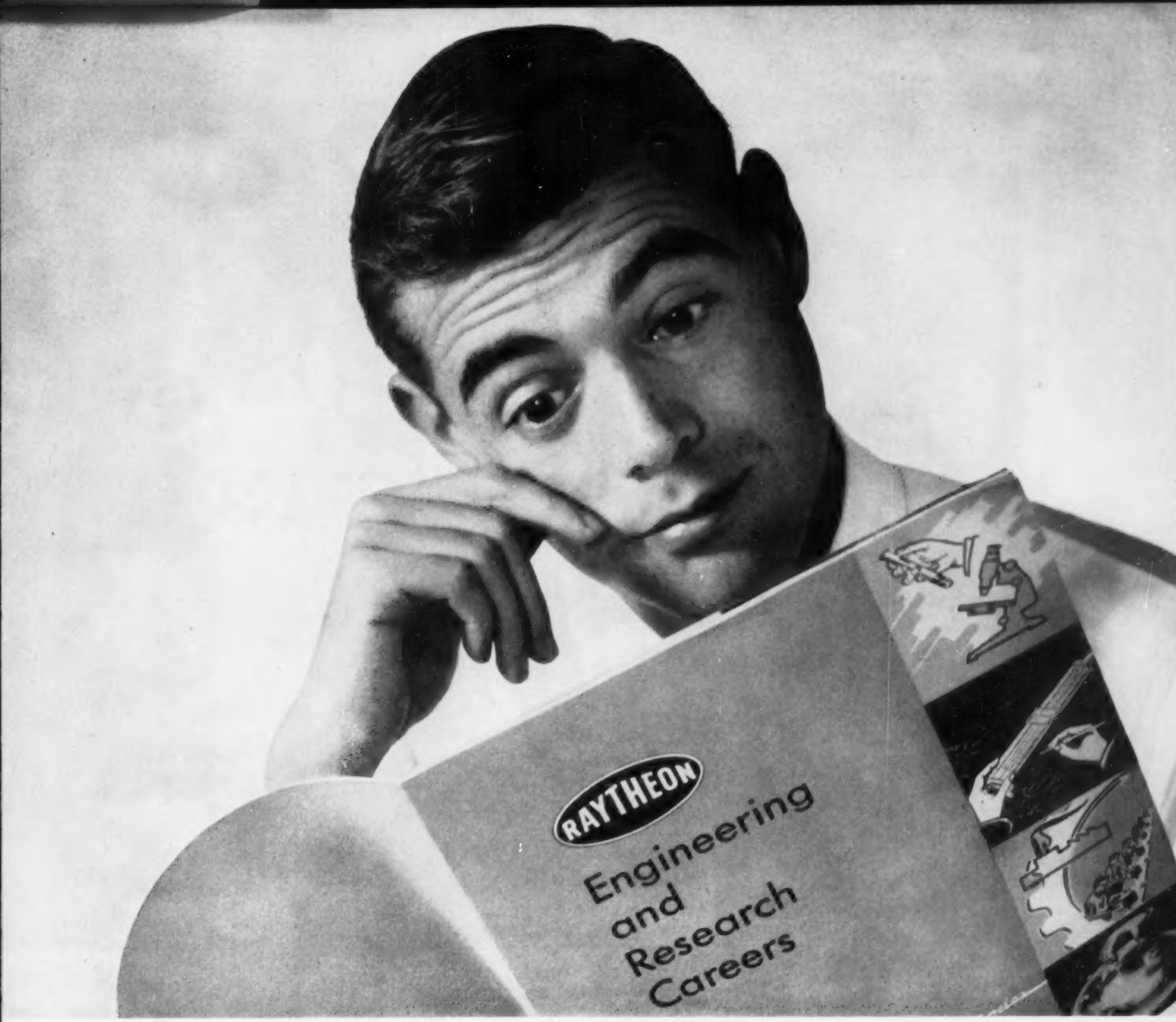
Modern Telephone Cable Systems

The first installation to use this system and type of telephone cable was the Key West to Havana cable laid in 1950. It is 125 miles long and

(Continued on page 65)



Machine for the manufacture of telephone cable.


RAYTHEON
Engineering
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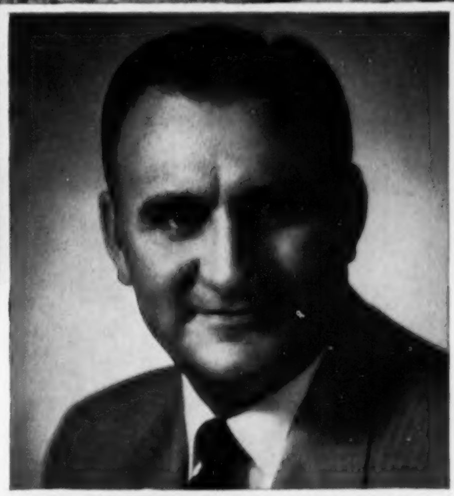


Charles C. Ingram, Jr. became Vice President of Oklahoma Natural Gas Company in less than 15 years

CHARLES C. INGRAM, JR.
B.S. in Petroleum Engineering, 1940
University of Oklahoma

Charles Ingram has been Vice President of the Land and Geological Department of Oklahoma Natural Gas Company since June of 1955. Mr. Ingram joined the company immediately after his graduation from Oklahoma, and was soon called into service. Following his discharge, 5 years later, he rejoined the Engineering Department in Tulsa. He was quickly promoted to Assistant Chief Engineer and then took over the position of Superintendent of Gas Purchase and Reserves, and by 1954 was District Superintendent of the Oklahoma City district.

After 6 years with Lone Star Gas, Bill Collins took over a new job in a new field for the company

WILLIAM A. COLLINS, JR
B.S. in Mechanical Engineering, 1947
A & M College of Texas

Bill Collins is employed by the Lone Star Gas Company in Dallas as Coordinator of Air Conditioning and Utilization. Bill operates over 400 square miles in North Texas and Southern Oklahoma. Since joining Lone Star, Bill has worked primarily in the design, sales and installation of air conditioning equipment, with some time devoted to industrial gas applications. When it was found that a large scale air conditioning program requires close attention to design and installation as well as sales and service policies, a special department was organized in 1955. Bill was put in charge.

SOVIET TECHNICAL EDUCATION

The following article is based on the results of a study of the Soviet educational system currently being conducted by Massachusetts Institute of Technology under the direction of Dr. Leon Trilling. Dr. Trilling, a professor in the Aeronautical Engineering Department of M.I.T., is particularly well qualified to direct this phase of the study, dealing with Soviet aeronautics. The information in this article comes from just one part of the M.I.T. investigation—other branches of Soviet education are being studied currently to obtain a report covering all phases of Soviet education and comparing them to our own. The editors believe this information is of particular interest to the engineering student reader who may participate in the technological race between Russia and the United States.

The quality of Russian scientists and the Russian educational system has aroused the curiosity of the American people, who are constantly being amazed at the Russians' advancement in warfare. With an eye on the accomplishments of the Russians, many people have asked the following:

Just how good are Russian scientists and engineers compared with our own, what is their educational system like, and is it equivalent to the educational system in this country?

Seeking to find at least a part of the answer to these questions, Dr. Leon Trilling, an aeronautical engineering professor at M.I.T., prepared an article on Soviet aeronautical education, under the planning of M.I.T.'s center for international studies. This is the first article completed in the Center's report on Soviet education.

The Soviet educational system has trained a small but elite corps of aeronautical scientists who are second to none. "These top scientists acting as small flexible task forces, have solved a number of theoretical questions . . . selected to keep Soviet aeronautical science abreast of any competitor."

But, adds the M.I.T. report, the Russian technical leaders are perched on a shaky engineering base.

"The full cross section of engineers in the Soviet Union," says Dr. Trilling, "have apparently not yet acquired that degree of engineering 'feeling' which only broad familiarity with machinery can bring. They work by the book and require detailed direction.

"For this reason, excellent designs must frequently be adapted to inferior execution, and tooling or high-grade workmanship is reserved for only key parts of the assembly."

Another important aspect of the Soviet educational system is that it trains skilled technical personnel for the service of the state, usually without regard to personal feelings. "The constant subordination of the individual to the national plan," says Dr. Trilling, "is an important psychological influence on professional people in the Soviet Union."

Dr. Trilling's findings were based on official and technical Soviet publications and on the testimony of witnesses, both Westerners who have visited Russia for various lengths of time and former Soviet citizens who have either studied or taught in the Soviet Union within the last ten years.

"On the basis of the evidence," says Dr. Trilling, "it is our conclusion that there exists in the Soviet Union a group of talented people with drive and ambition who are generally permitted to reach the top, sometimes quite rapidly, and

Kalnin Polytechnic Institute in Leningrad is one of 180 schools turning out top-grade engineers. It has an enrollment of 11,000 students.

that their number has increased as a direct result of Soviet educational policy.

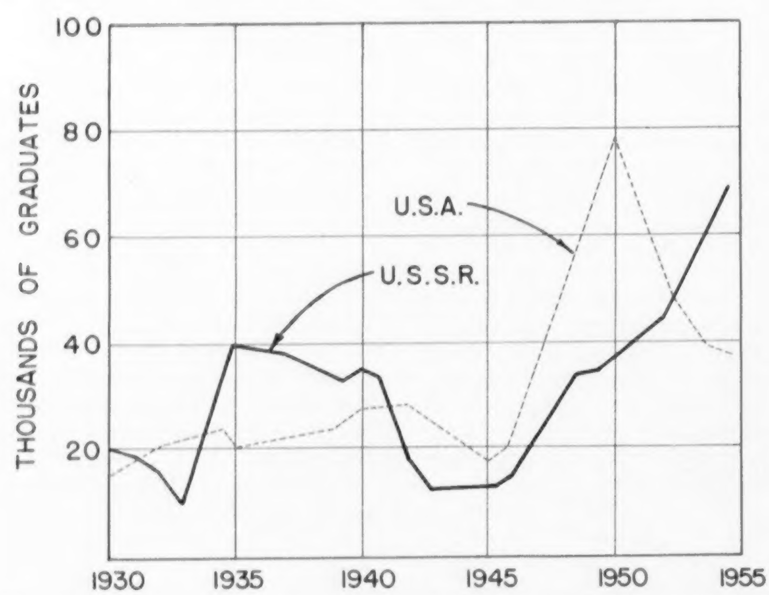
"But there are still only a few men who carry the Soviet engineering apparatus on their shoulders, being simultaneously teachers, scientists, and designers.

"There can be little doubt that the ability and knowledge of this key nucleus is on a par with that of the best men in similar positions anywhere, but that at the present time these men do not have adequate support," that is, the technical support of a well-balanced body of engineers and technicians.

Soviet Training vs. American Training

The Trilling study is the first to examine in close detail the qualitative aspects of a single segment of Soviet technical training. The author notes that aeronautical engineering receives special attention and possibly illustrates their best efforts. His conclusions are based on the pattern of "vertical integration" which is typical of technical training in Russia.

Vertical integration means that in general the segments of Soviet professional programs are defined by the industrial monopolies.



Manpower race shown in chart reveals how U.S. production of physical scientists and engineers has sagged since post-war peak. Russia's has steadily increased by an average of 6,000 a year since 1945.

This is the opposite of the familiar "horizontal" pattern of subject matter divisions found in the United States. In this country, for instance, a man trained as an electrical engineer has a wide range of employment opportunities. He may seek a job with a firm manufacturing electric appliances, or with a telephone company to improve the efficiency of communication networks, or with an aircraft builder to design automatic control or radio equipment. This is the horizontal approach to engineering education. It stresses versatility and fundamentals. This horizontal approach requires institutions which are independent of productive facilities.

In the Soviet Union the situation is altogether different. Responsibility for the productive activity of the nation is divided among a small number of powerful ministries, each of which has full charge of a definite segment of the industrial economy. Each ministry is responsible for many services and much auxiliary equipment needed in its main task: housing in newly developed areas, factory construction, light and specialized tooling, control equipment, safety equipment. In particular, each ministry trains in its own institutes the skilled personnel—engineers, economists, and others—necessary for its operations. This is vertical integration.

Disadvantages of Soviet System

Dr. Trilling finds that one of the chief weaknesses of the Soviet system is its inevitable duplication. A mechanical engineer of the Ministry of Aircraft Production, for example, may be trained to design the same valves and piping as one in the Oil Production Ministry without any interchange of information between the two.

Yet the system also permits a flexible use of top technical people within any given ministry. Key men carry a variety of responsibilities. They lecture at the university, supervise research at the aeronautical institute, serve as consultants to the industry itself.

This "multiple hat" system works with apparent effectiveness. The system also permits concentrated and integrated attack on any given problem. It has had its obvious successes.

"Recent press reports," Dr. Trill-

ing notes as an example, "have indicated that the Soviet aircraft industry has produced turbojet engines appreciably more powerful than those in mass production in the United States at the present time.

"While know-how and ideas from German and other sources have helped in this Soviet accomplishment," he adds, "they would not have been absorbed and put to effective use so rapidly if native groups had not mastered the fundamentals of the problem independently and prepared a sufficient number of engineers to extend and improve good borrowed ideas in an original and skillful manner."

Moscow University is Soviet showpiece. Tower is 33 stories high and the campus covers 413 acres. It is one of 33 schools which turn out pure scientists.

In spite of the Soviet strength in science and applied science, says Dr. Trilling, their situation appears less favorable in engineering.

"In the sciences," he notes, "there existed a solid pre-Revolution base which required only to be broadened. In engineering the Soviet system started almost from scratch.

"Moreover, the Soviet regime undertook the task of training a large engineering force while at the same time enormously expanding the national industrial machine. Appreciable progress has been made in both directions, but much remains to be done to create a technical base comparable in engineering instinct to the American or German base."

Few Graduate Students in Russian Schools

The number of graduate students at Soviet technical schools is also uniformly low, ranging from two per cent of the student body at Bauman Technical School in Moscow down to zero at many of the outlying institutions. This contrasts to thirty-eight per cent at the Massachusetts Institue of Technology, and an average of twelve per cent in American technical schools generally.

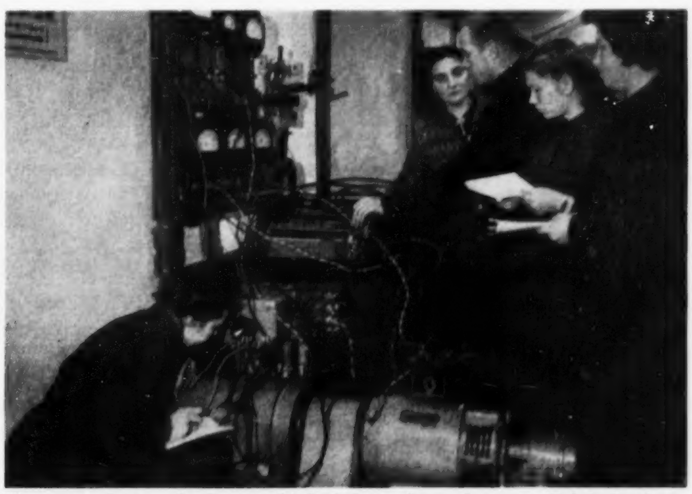
"The Soviet situation," says Dr. Trilling, "may be the result of a deliberate policy which aims to get engineers into the industrial stream as quickly as possible and to enable the senior professors to educate the best graduates as carefully and thoroughly as possible."

But it also appears that insufficient contact with mature creative teaching personnel and a strong emphasis on factual knowledge useful for immediate applications in design and manufacture have limited the number of young people who give promise of originality and show an interest in research by taking an advanced degree.

This has resulted in the present emphasis on graduate correspondence courses, the financial rewards offered for an advanced degree, and the fact that the scientist is now praised as the prime builder of the Soviet state—a trend that is likely to become stronger.

"Although a long-range Soviet policy of industrial expansion in the future and the training of additional teachers should provide an increasing supply of engineers," concludes the M.I.T. study, "it is doubtful whether they will generate sufficient self-reliance in technical matters without extensive changes in the entire Soviet approach to the problem of education."

Fine equipment like this sensitive chemical balance being used at Kalnin Institute is as good as any now in use in U.S. colleges.



Women students, who form a third of the undergraduates at Kalnin Institute, gain electrical engineering experience by working on generator equipment.

Natural Gas

Edited by Gail Marsh, EE '61

The history of the natural gas industry is a tribute to private enterprise. It is the story of modern-day pioneering in the best American tradition, of scientific knowledge supplanting ancient superstitions, of engineering skill conquering nature at her toughest; and it is the story of men who gambled billions of dollars to make the world's oldest natural resource available to the American public. That this combination paid off is proved by the fact that today the 16 billion dollar gas industry is the sixth largest (in terms of total investment) and the fastest growing industry in the United States.

People frequently think that gas and oil are found in huge subterranean caverns. On the contrary, both gas and oil are imbedded in minute pores of rocks, such as sandstone or limestone. They are held captive under great pressure by surrounding rock formations that are impervious to seepage until shifting of the earth's surface cracks the "cap rock" or it is penetrated by the producer's drilling bit.

For thousands of years men knew of the existence of natural gas but lacked the knowledge to produce, transmit and distribute it in quantity. In Europe, during the 18th Century, scientists were busy experimenting with "manufactured" gas, made by distilling coal. By 1807 they had succeeded to the point where gas was being used to light the streets of London and, in 1812, the first gas company in the world was founded in that city.

Natural Gas Posed Problems

Natural gas, however, still remained more of a problem than a boon. Even as late as 1859, when the first oil well was built in this country in Titusville, Pennsylvania, producers were dismayed to find natural gas clinging to the oil. Consumers were more than satisfied with manufactured gas and the problems of transmitting natural gas over long distances made it impractical to try to compete with or supplant the man-made fuel.

By 1900, natural gas had been discovered in 17 states, but the total production for that year was sold for less than $25,000,000. Then in 1925, long distance natural gas transmission lines got their first real start with the development of seamless, electrically welded pipe. This made transportation profitable and within five years the consumption of natural gas rose to 1.9 trillion cubic feet.

But the real beginning of the giant natural gas industry came with the outbreak of World War II and construction of the famous Big Inch line in 1942 as oil carrier to bring needed oil to the Eastern seaboard.

With the end of the war, the gas industry acquired these vast pipeline systems from the government, repaying the $143,127,000 cost of building them, and by installing giant compressor stations about every hundred miles, converted the oil line into a natural gas transmission line. The problem of transmission was licked at last.

The industry's solution of the complicated and costly problem of transmission—bringing the gas from the well head to the consumer—is also the story of indispensable underground arteries, vast networks of pipelines extending for thousands of miles across mountains and plains, swamps and deserts, rivers and highways.

Pipeline construction averages $150,000 a mile. Since 1942, over 65,000 miles of long distance, large-diameter pipelines have been laid from the rich oil and gas fields of Texas and Louisiana to the major population centers of the country. The installation of huge compressor units, capable of 4,400,000 total horsepower, brought the cost of this tremendous expansion program to more than $5,000,000,000 in the last 13 years. Exploration costs swell this figure even more.

Natural gas is found in two ways: in combination with oil, and in gas wells buried deep in the ground. The only way to find gas is to drill for it. But natural gas defies detection by ordinary electronic and geological methods. Geologists using seismographs and gravity meters can find formations which are ideal for holding gas far below the earth's surface, but the only way of being certain that gas exists in these subterranean pockets is to drill for it.

This is a complicated and costly process called "wildcatting"—drilling in unexplored areas. The average cost of drilling each well is over $100,000 and can even run as high as several million. Since only one out of every nine wells drilled yields gas, and only one out of every 40 of these produces enough gas to make the venture profitable, drilling is an expensive gamble.

Methane is the hydrocarbon that forms the bulk of the natural gas we burn in our homes. The other hydrocarbons such as propane and butane, are used for many industrial purposes—as raw materials in the manufacture of plastics, fertilizers, and synthetic fabrics such as Orlon, or as differ-

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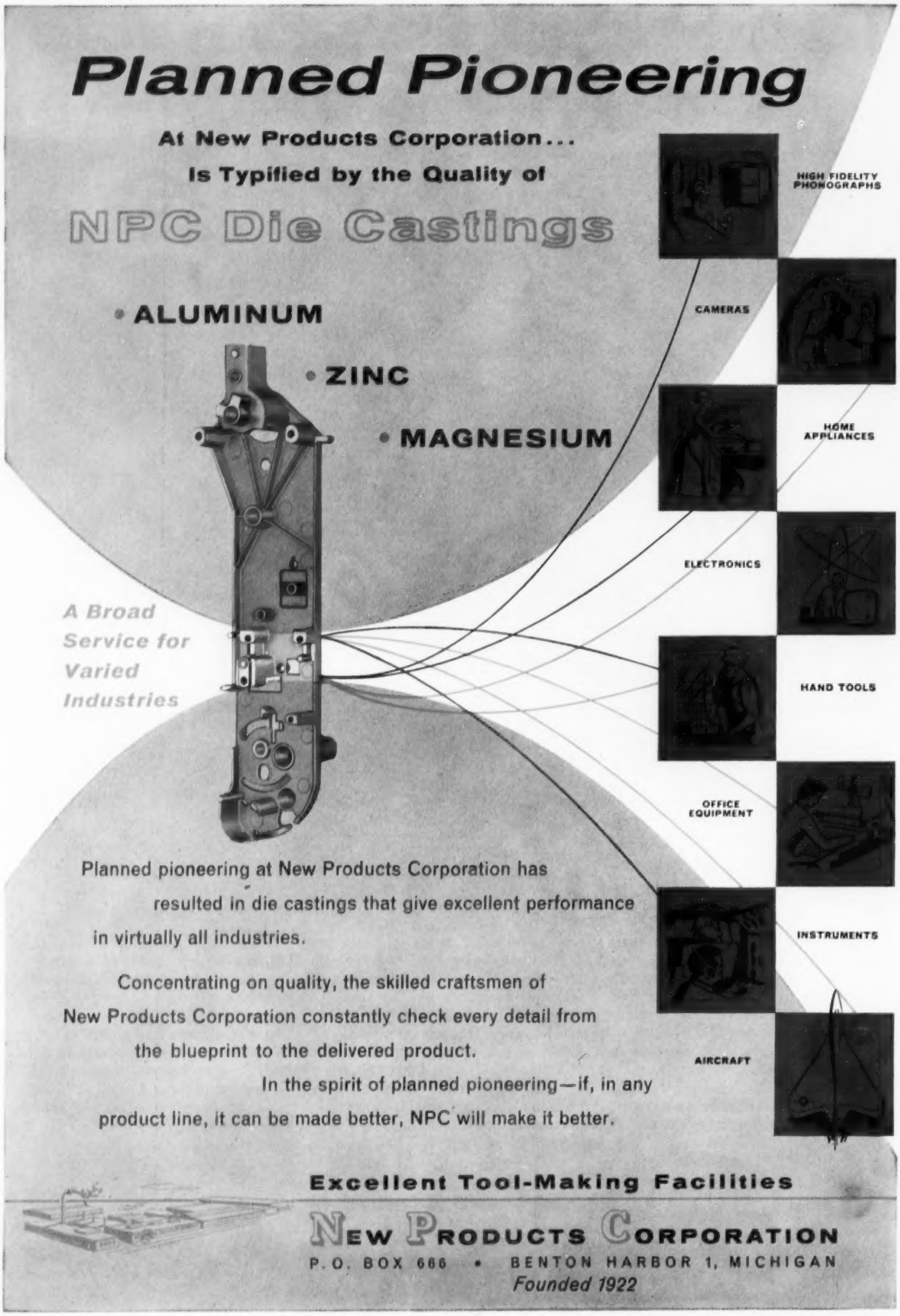
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• MAGNESIUM
A Broad Service for Varied Industries
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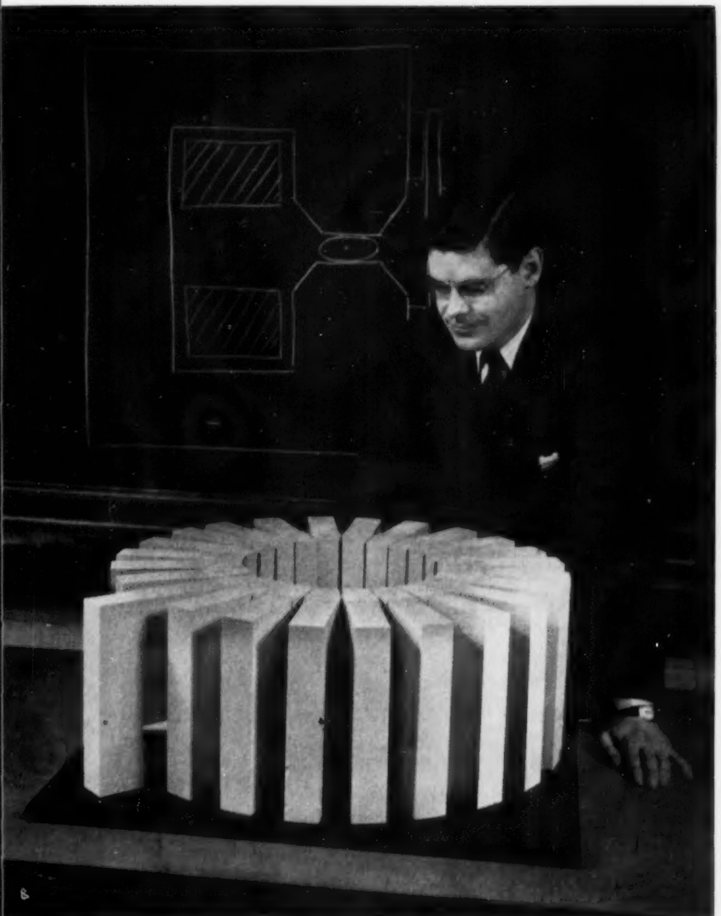

Faculty Profile . . .

Professor ROBERT R. WILSON

by

Alan Carlin, EP '60

Time is a precious commodity to most busy people; therefore, I expected to have to put up a good argument in order to induce Dr. Robert R. Wilson, Director of the Newman Laboratory of Nuclear Studies, to submit to an interview. Thus, when his secretary offered to ask him, I was a bit dubious; for as any door-to-door salesman knows, it is harder to say no to a person's face than through a second party. However, forced by circumstances to accept this solution, I was determined to receive the answer in person rather than over the telephone, as his secretary suggested. Such precautions were unnecessary, however; as his secretary told me, Dr. Wilson "just isn't that kind of man." In fact, it is such good human relations as he practiced with me that help make Dr. Wilson such a capable administrator.

Dr. Wilson is more than an administrator, however; he is also an active scientist, teacher, husband, and father of three small children, and thereby a living exception to Sinclair Lewis' *Arrowsmith*. Like Dr. Arrowsmith, his feeling for science might almost be termed a fervor. "Watching an experiment unfold," he stated, "is more exciting than watching any sporting contest." On the other hand, he modestly likened this passion for science to that of a sports enthusiast. A definite difference exists between the two, however; while following athletics is an avocation to the sports enthusiast, science is a vocation for Dr. Wilson. Perhaps this fact, that his vocation is to him as an avocation is to other men, is one of the secrets of his evident happiness and satisfaction in his work. There are other reasons, however, which I hope will become evident as I outline the salient events of his life to date and the work of the laboratory which he heads.

Dr. Wilson's interest and aptitude in science is of long standing. Born at a small town called Frontier, Wyoming, he was infected early with the germ of the wide open spaces. This, together with the frequent movements of his family and his curiosity, probably created his early interest in geology. Later, during his high school years, which he spent in California, his interest was stimulated further by the proximity of the Sierras. At this same time, however, he also exhibited a flare for physics; while still in high school, he began to build apparatus. For instance, he learned to blow glass, and, later, built a mercury diffusion pump and worked with oscillographs.

Although guided to his life work in nuclear research only by his interests, he found that he had indeed made the right choice. While he enrolled in electrical engineering when he entered the University of California in the early 1930's, he switched to the status of a physics major in the arts college at the end of his first year. This decision, he says, was based upon his interest in

the subject and the thought that there would always be a need for physicists. Although he took little part in extra-curricular activities, he soon became a prodigy in his chosen field, which was perhaps already supplying some of the enjoyment which he was to derive from it later. While only a junior, he had an article published concerning his researches into the lag which occurs between the time when a voltage is applied across a gap and the time when a spark occurs. His first problem was measuring the minute amounts of time involved. He not only solved this, by developing a method of measuring times as small as 10^{-9} second, but also developed a theory to account for his observations. His graduate work, which he did in the field of nuclear physics at Berkeley, was no less astounding. For his Ph.D., which he received in 1940, he studied the forces acting between protons and the theory of the cyclotron.

In the fall of 1940, he became an instructor at Princeton, where he continued his study of the proton. Although he was actually interested in such a combination research and teaching position, the war interrupted this career and involved him in one of the most rapid expansions any branch of science has ever known. After only a few months at Princeton, he enrolled in the radiation laboratory in Boston in which microwave techniques were being developed, but returned to Princeton shortly afterward. There, along with Dr. E. C. Creutz and in collaboration with Dr. Enrico Fermi and his group at Columbia, he first studied resonance absorption of neutrons by U-238. This study was important as it determined whether a sustained chain reaction was possible; if the absorption were too large, too few neutrons would be left over to cause fission of sufficient U-235 to keep the reaction going. Fortunately (although some cynics have often questioned this), such did not prove to be the case. Further measurements constituted the first determination of the optimum size, shape, and spacing for lumps of uranium in the matrix of moderator to produce an atomic pile.

On hearing of the results of experiments carried out in England on the fission of U-235, which showed that a bomb was feasible if pure U-235 could be obtained, Dr. Wilson suggested a novel method of separating the isotope from the more common U-238 in the late summer of 1941. Called the "isotron," process, it used an extended ion source instead of one limited essentially to one dimension, as in the slit system of the calutron mass separator. Although the process overcame one of the three major difficulties which limited the production of the calutron separator, namely, the sharply limited ion beam and was, in fact, one of the three most seriously considered electromagnetic methods of separation, the project was finally abandoned when progress was not as rapid as had been hoped during the summer and fall of 1942. This action was taken in order that the personnel could be sent to the site of the new atomic bomb laboratory at Los Alamos, New Mexico. Before the group left Princeton, however, a small experimental isotron collected several samples of partly separated uranium.

Dr. Wilson's first assignment after leaving Princeton was to purchase a cyclotron, move it to Los Alamos, and there to run it. Perhaps the most difficult part of the task was to obtain the Harvard cyclotron without disclosing why or where it was to be moved. On the pretext of purchasing it for medical research in St. Louis, Dr. Wilson appeared in Cambridge in the company of an army doctor and lawyer, who were actually members of the Corps of Engineers: Dr. Wilson and the doctor wore medical insignia, while the lawyer was supposedly dressed as a civilian (although several people noted assorted pieces of uniform showing). Since the Harvard scientists had no intention of selling their machine for such a purpose, the transaction might have been stalemated if the Harvard negotiators had not guessed what the actual purpose must be. Finally, after some anxious moments, the transaction was completed on the basis that Dr. Wilson could not have it if he wanted it for what he said he wanted it for, but could if he wanted it for what the Harvard men thought he wanted it for.

Dr. Wilson was among the first to arrive at Los Alamos, located at the site of a small boarding school atop a mesa about thirty miles from Sante Fe, and the cyclotron was not far behind. Although shipped by way of the St. Louis medical depot, it was in operation within a month, something of a record. Later, he was put in charge of the Experimental Nuclear Physics Division, one of seven administrative divisions. His division spent most of its time investigating the quantities of uranium and plutonium needed to make a bomb. Another Cornell professor, Dr. Hans A. Bethe, was head of the Theoretical Physics Division, and Dr. Robert F. Bacher, first director of the Cornell Laboratory of Nuclear Studies, was head of the Bomb Physics Division.

Everyone was tense on that fateful morning of July 16, 1945, when the first atomic bomb was exploded at Alamorgordo Air Base in the New Mexican desert; this tension was heightened further by the elements, which poured forth rain and lightning up to the zero hour, 5:30 a.m. The only conspicuous feature of the scene was a steel tower on which the bomb had been assembled during the previous three days. Shortly before 5:30, Dr. Wilson, who was in charge of nuclear measurements, approached the tower to start the electronic equipment, which was to measure the production of neutrons. Even when he retired to an observation point some five miles away, his worries were hardly over. Besides the general anxiety as to whether the first atomic bomb, the product of a two billion dollar research program, would, indeed, explode, he had to worry about the safety of his men since the wind was blowing in their direction. Then, at precisely 5:30, a searing light illuminated the whole country with an intensity many times that of the mid-day sun. Shortly afterward came the shock wave, followed almost immediately by the sound waves. While Dr. Wilson had little time to speculate about the meaning of this awesome spectacle at the moment, as he was forced to order an evacuation in order to avoid the radioactive contamination from a possible fall-out, it had a profound effect upon his thinking, as it did on many others pres-

(Continued on page 55)

College News

CAL DEVELOPS LACROSSE MISSILE

A new guided missile, the Lacrosse, has been developed here by Cornell Aernautical Laboratory, Inc. It is a surface-to-surface guided missile for close support operation on the battlefield.

The Army, in announcing the new missile, said, "In development of Lacrosse, emphasis has been placed on accuracy and mobility." Cornell Laboratory described Lacrosse as "a deadly accurate weapon system," and stated that "test firings at White Sands Proving Ground, New Mexico, had been particularly successful."

Essential components in the system are the missile, a launcher mounted on a standard Army truck and a guidance station. Designed and developed at Cornell Aeronautical Laboratory under Army Ordnance contract, the new missile is being produced by Glenn L. Martin Company, of Baltimore, Md.

Need for the surface-to-surface weapon was outlined by the Marine Corps in 1947. Responsibility for its development was placed on high priority with Army Ordnance in 1950, shortly before the Korean War began. Cornell Laboratory has been prime contractor for the total system throughout the design and development phases.

First effort on the Lacrosse system began in 1947 as a feasibility study by Cornell Laboratory, in cooperation with the Applied Physics Laboratory of Johns Hopkins University. In 1949 C.A.L. received a research and development contract.

The new missile went through various stages at Cornell including preliminary study, design, analysis, fabrication and test, and final development. The Laboratory concluded its test firings at White Sands Proving Ground only this summer.

In the field of missile research, Cornell Aeronautical Laboratory has been an active contributor since 1944 when it played a vital role in developing supersonic ramjet missiles under the Navy's Bumblebee program. Other missile programs, besides Lacrosse, have been recently active at the Laboratory; however, details remain classified.

RCA AWARDS FELLOWSHIP

Cornell's RCA Fellowship for graduate study in engineering physics has been awarded to Jack M. Ravets.

The Radio Corporation of America has given $3850, which is divided between the winner and the Department of Engineering Physics.

The fellowship, established at Cornell in 1949, is part of a nationwide program sponsored by RCA. The RCA Education Committee chooses recipients from among students recommended by participating universities.

Mr. Ravets received a bachelor of science degree in June from New York University, where he was top member of his class at the University Heights campus.

At NYU he was a laboratory assistant on a simulated underwater explosion project supported by the Navy Bureau of Ordnance. He is studying for a doctorate at Cornell, and plans to go into teaching and research.

CORNELL RANKED IN DEGREE STUDY

The National Research Council has ended a 10-year study with the publication of a 158 page book which tells where U.S. scientists earned bachelor's and doctor's degrees between 1936 and 1950. The survey was headed by M. H. Trytten, director of the Office of Scientific Personnel.

The study compares the two intervals: from 1936 through 1945 and from 1946 through 1950. In the first period Cornell University led in the production of science doctorates with 851. In the second period Cornell was second with 559 Ph.D.'s awarded.

PETERSON WINS BELL LAB FELLOWSHIP

Harry C. Peterson was one of fifteen outstanding college students working for their doctor's degrees who were named to receive the 1956 Bell Telephone Laboratories Graduate Fellowships.

The fellowships, awarded for the first time this year, were established to encourage study and research in engineering and science related to communications technology. Each fellowship is for one year and carries a grant of $2,000 for the fellow and another $2,000 for tuition, fees and other costs of the academic institution he selects for his study.

The new Graduate Fellowship awards are based on candidates' demonstrated ability, the relevance of their graduate program to the broad field of communications technology, and the likelihood of their professional growth. Applicants are expected to include students in the fields of electrical engineering, physics, mathematics, mechanical engineering, chemistry and engineering mechanics. The awards are made on recommendation of a committee of scientists and engineers from the technical staff of Bell

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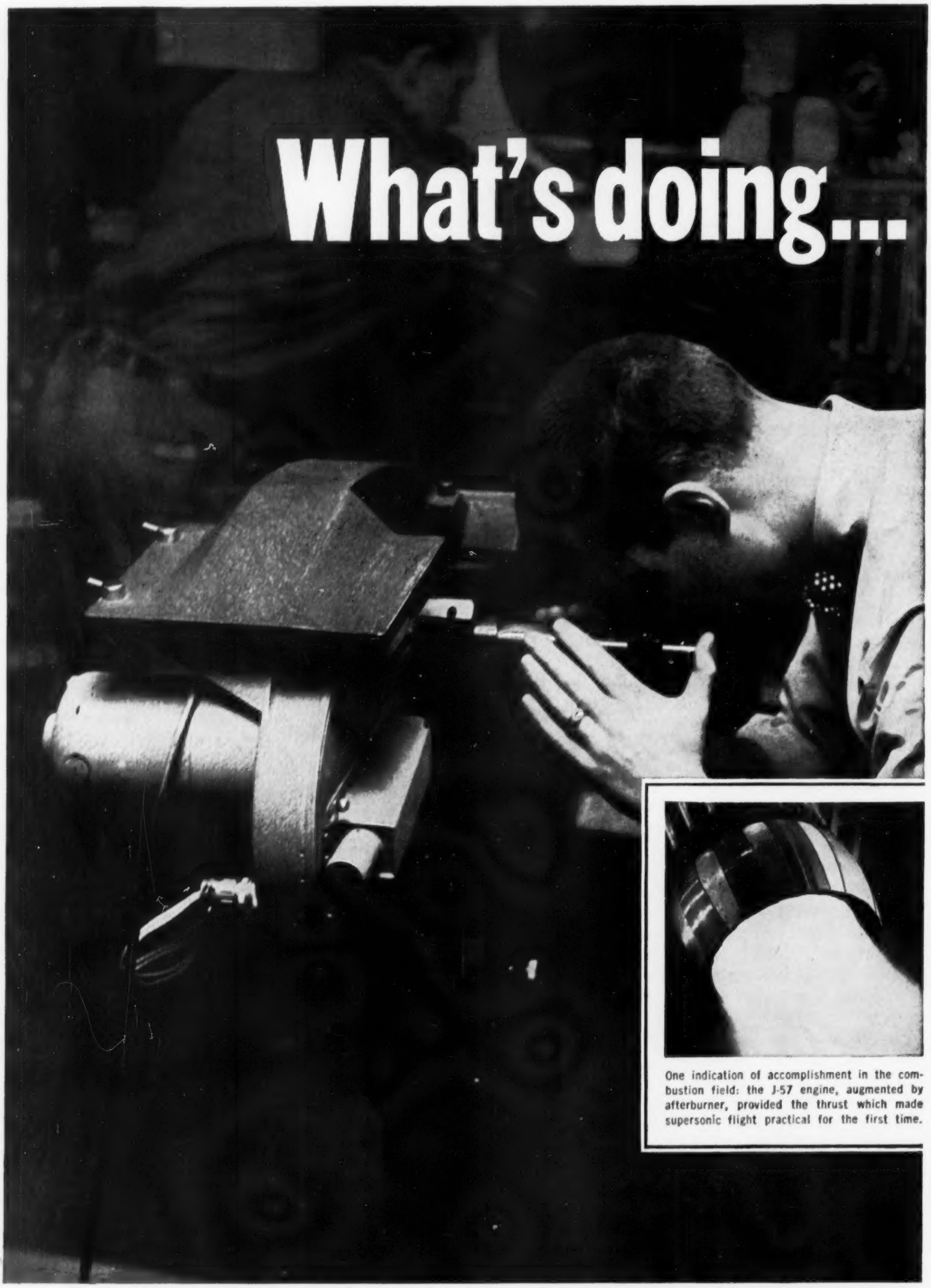
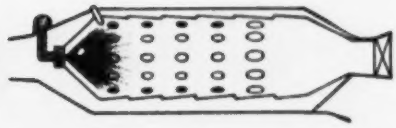


One indication of accomplishment in the combustion field: the J-57 engine, augmented by afterburner, provided the thrust which made supersonic flight practical for the first time.

This special periscope gives Pratt & Whitney Aircraft engineer a close-up view of combustion process actually taking place within the afterburner of an advanced jet engine on test. What the engineer observes is simultaneously recorded by a high-speed motion picture camera.

at Pratt & Whitney Aircraft in the field of Combustion*



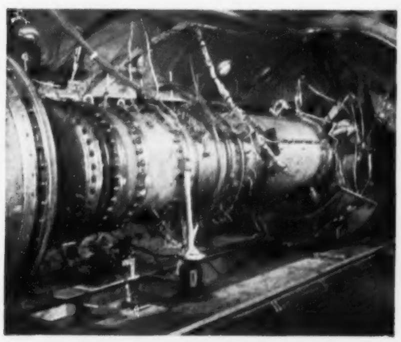
Historically, the process of combustion has excited man's insatiable hunger for knowledge. Since his most primitive attempts to make use of this phenomenon, he has found tremendous fascination in its potentials.

Perhaps at no time in history has that fascination been greater than it is today with respect to the use of combustion principles in the modern aircraft engine.

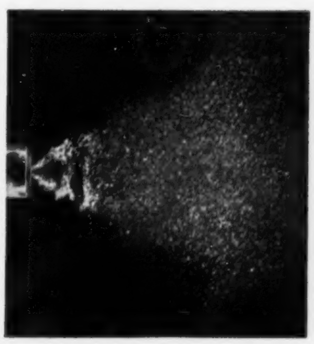
At Pratt & Whitney Aircraft, theorems of many sciences are being applied to the design and development of high heat release rate devices. In spite of the apparent simplicity of a combustion system, the bringing together of fuel and air in proper proportions, the ignition of the mixture, and the rapid mixing of burned and unburned gases involves a most complex series of interrelated events — events ocurring simultaneously in time and space.

Although the combustion engineer draws on many fields of science (including thermodynamics, aerodynamics, fluid mechanics, heat transfer, applied mechanics, metallurgy and chemistry), the design of combustion systems has not yet been reduced to really scientific principles. Therefore, the highly successful performance of engines like the J-57, J-75 and others stands as a tribute to the vision, imagination and pioneering efforts of those at Pratt & Whitney Aircraft engaged in combustion work.

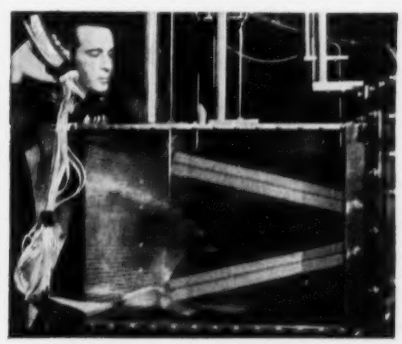
While combustion assignments, themselves, involve a diversity of engineering talent, the field is only one of a broadly diversified engineering program at Pratt & Whitney Aircraft. That program—with other far-reaching activities in the fields of instrumentation, materials problems, mechanical design and aerodynamics — spells out a gratifying future for many of today's engineering students.



Mounting an afterburner in a special high-altitude test chamber in P&WA's Willgoos Turbine Laboratory permits study of a variety of combustion problems which may be encountered during later development stages.



Microflash photo illustrates one continuing problem: design and development of fuel injection systems which properly atomize and distribute under all flight conditions.



Pratt & Whitney Aircraft engineer manipulates probe in exit of two-dimensional research diffuser. Diffuser design for advanced power plants is one of many air flow problems that exist in combustion work.

**Watch for campus availability of P & WA color strip film on combustion.*

World's foremost designer and builder of aircraft engines

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Division of United Aircraft Corporation

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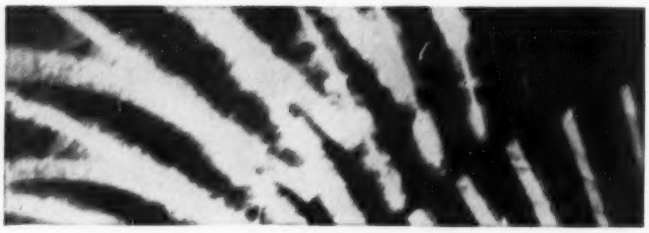
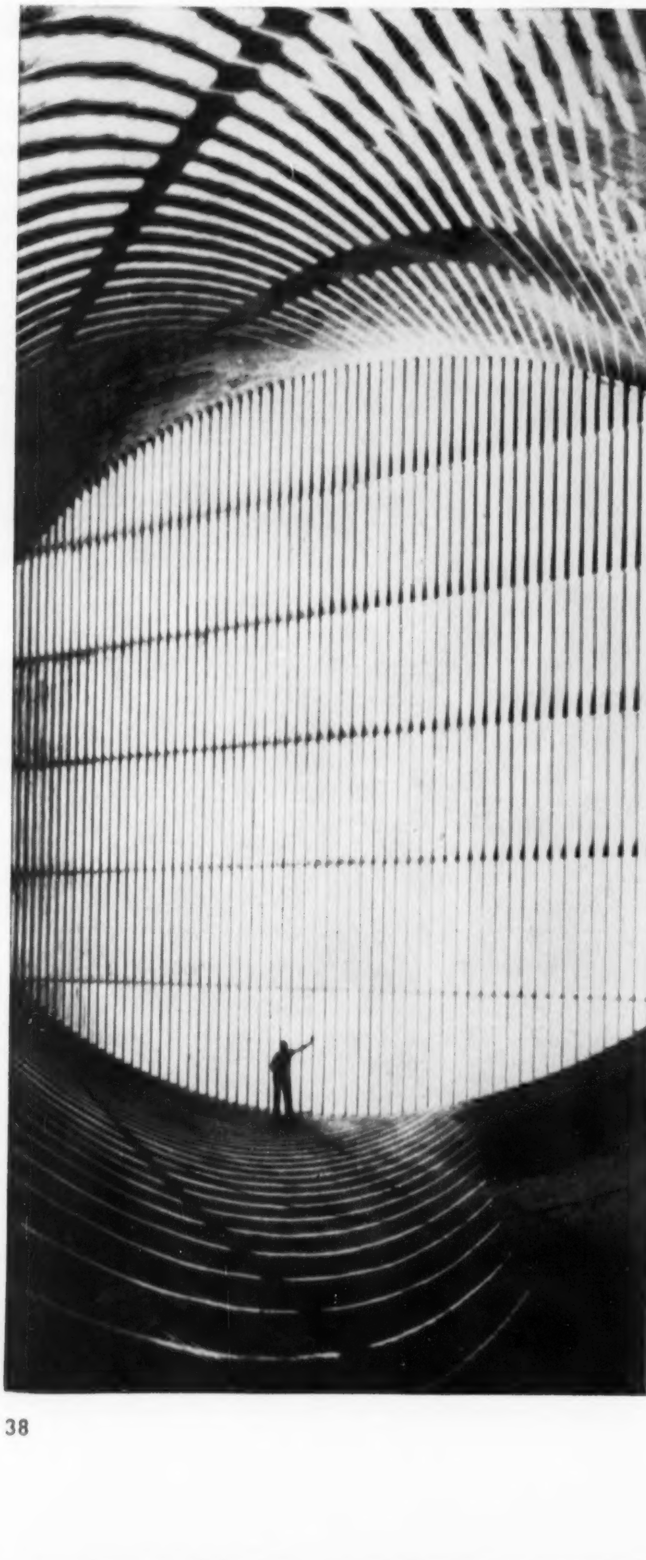




"A new era is beginning...

"As I review the progress in aeronautics within so short a span, and marvel at the complex aircraft of today, I call it an achievement little short of miraculous.

"Today, electronically-guided planes take off and land without human touch. Lethal sky missiles seek and destroy invisible targets with uncanny precision. And still other fantastic achievements in both man-controlled and pilotless flight are now in the offing.

"When men go to the moon and planets, electronically-controlled skycraft will take them there. Aviation maps will be studded with stars as well as with cities. New developments in aeronautics will go on and on. Success opportunities and careers will continue to develop for ambitious young men in this exciting field where a new era is beginning."*

LEE De FOREST

Appropriately qualified to speak for aeronautics and other fields in which his own scientific achievements play an important part, Dr. Lee de Forest gives helpful counsel to young graduates headed for successful, rewarding careers.

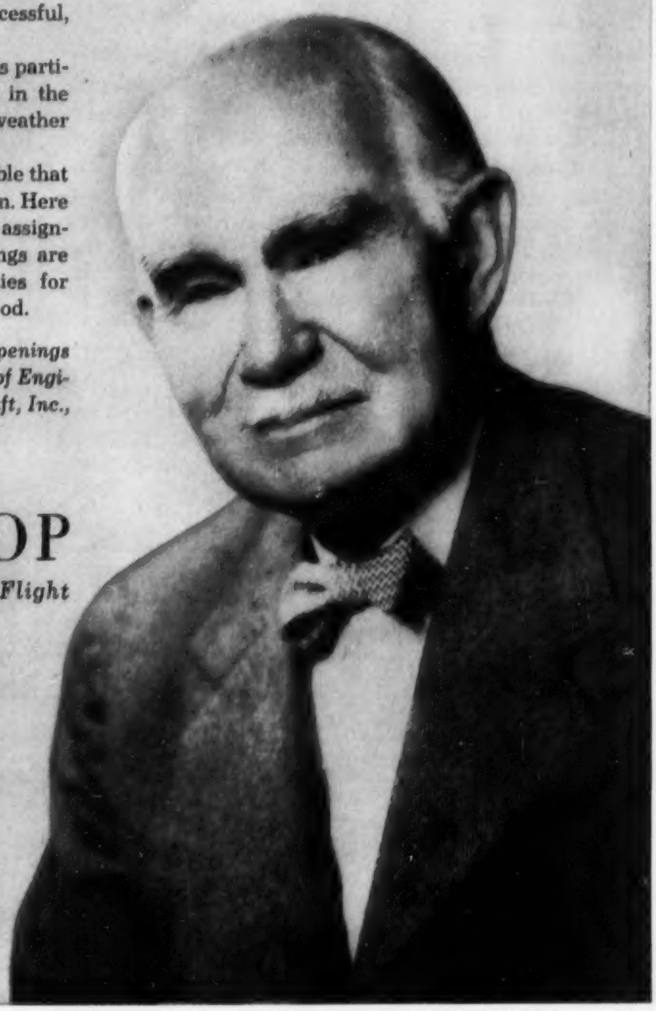
His expression, "a new era is beginning," has particular significance at Northrop, world leader in the design, development and production of all-weather and pilotless aircraft.

At Northrop, permanent positions are available that offer full play for individual talent and ambition. Here the graduate engineer will find interesting assignments for which he is best fitted. Surroundings are attractive, co-workers congenial, opportunities for advancement unceasing, the compensation good.

For detailed information regarding specific openings in your field of specialization, write Manager of Engineering Industrial Relations, Northrop Aircraft, Inc., 1001 East Broadway, Hawthorne, California.

NORTHROP

Pioneers in All Weather and Pilotless Flight



**A statement by Dr. Lee de Forest, pioneer in radio.*

HONEYWELL MEN ADVANCE RAPIDLY!

The ability to accept and discharge responsibility, and to plan and execute programs mean advancement. Men who get things done, get better jobs.

Such is the case at Honeywell. Ability, drive and the spirit of team play—combined with education and experience—determine where and how fast you progress. And our growth means we are always eager to find men with capacity for greater responsibility.

Who measures this? Your immediate supervisor does. He will speed your progress by seeking your ideas and opinions, by stimulating your interest and enthusiasm and by giving you additional responsibilities as you are ready to accept them.

Then, twice a year he will review your accomplishments with you and determine your salary increases. A program like this is assurance that contributions are rewarded by compensation and advancement.

There are other factors that accelerate advancement.

Engineers predominate among our vice-presidents, divisional executives and departmental managers. So, attitudes and opinions of our scientists and engineers are understood and supported by management.

Honeywell is composed of small units working as a team. These units multiply opportunities for early managerial experience and lay the foundation for more important management assignments in future years.

HONEYWELL OFFERS MANY EXTRA BENEFITS!

The importance of benefits in career planning cannot be underestimated. Honeywell's program ranks as one of the most liberal in industry. There's free group life insurance . . . free accident and sickness insurance . . . free hospital insurance. You will find a liberal policy on paid vacations and holidays and modern pension and retirement program paying lifetime benefits.

HONEYWELL PLANTS ARE LOCATED ALL ACROSS THE COUNTRY AND ABROAD!

If you have a geographical preference either in the U. S. or abroad, consider Honeywell's many engineering and production locations. You'll find challenging opportunities for a variety of engineering specialties with Honeywell in Beltsville, Md.; Boston; Chicago; Denver; Freeport and Warren, Ill.; Independence, Iowa; Los Angeles; Minneapolis; Philadelphia; St. Petersburg, Florida; Wabash, Ind.; and Toronto, Ontario.

Abroad, Honeywell factories are located in Amiens, France; Amsterdam, Netherlands; Frankfurt, Germany; Newhouse, Scotland and Tokyo, Japan.

If you prefer sales and application engineering you'll find 127 sales and service offices in principal cities across the nation and Canada, and 45 countries abroad.

HONEYWELL'S MAIN FIELDS AND LOCATIONS ARE:

Heating and Air Conditioning Controls: Engineering and manufacturing plants in Minneapolis, Chicago, Wabash and Los Angeles.

Industrial Instruments and Controls: Research, engineering and manufacturing plants in Philadelphia and Beltsville, Md.

Aeronautical Controls: Research, engineering and manufacturing plants in Minneapolis, St. Petersburg and Los Angeles.

Precision Switches: Engineering and manufacturing in Freeport and Warren, Illinois, and Independence, Iowa; research facilities in Denver.

Ordnance and Missiles: Engineering and manufacturing in Minneapolis, Monrovia, Calif., and Seattle, Wash.

Servo Components and Controls: Engineering and manufacturing plants in Boston.

Oscillographic and Photographic Equipment: Research, engineering and manufacturing facilities in Denver.

Transistors: Research, engineering and manufacturing plants in Boston.

Research: In addition to research and engineering activities carried on by various divisions, Honeywell also maintains a Research Center in the Minneapolis suburb of Hopkins. Prime concern of the Center is basic projects of interest to the entire organization.

Whichever Honeywell division or location you choose, you'll be assured of special training to help you grow in your job. This training includes regular on-the-job instruction, formal classes at the company and tuition-aid courses at nearby institutions.

HOW TO LEARN MORE ABOUT HONEYWELL!

A Honeywell representative can answer your questions and give you additional information about opportunities at Honeywell. Please consult your college placement office for the date of his next visit to your campus.

Meanwhile, you will want to read a booklet titled "Your Curve of Opportunity in Automatic Controls." Write H. T. Eckstrom, Personnel Administrator, Dept. CM, Minneapolis-Honeywell Regulator Company, 2753 Fourth Avenue, South, Minneapolis 8, Minnesota.

★Indicates location of Engineering-Research facilities

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TECHNIBRIEFS

"ERECTOR SET" CABINETS HOUSE ELECTRONIC EQUIPMENT

An ingenious new method permits industry to build cabinets to house instrumentation, automation, electronic, and electromechanical equipment from 75 mass-produced "building block" metal cabinet enclosures and 125 sub-parts, it has been announced by Elgin Metalformers Corporation, of Elgin, Ill.

The novel cabinet system is already used by the aviation, electronic, and petro-chemical industries, and by heavy manufacturers employing automated control equipment. Multi-million dollar computers and elaborate electronic brains are also going into the modular units. The Armed Forces are using these cabinets for vital control equipment at rocket launching and guided missle proving grounds. They have served for Atomic Energy Commission "H"-Bomb tests on Eniwetok atoll.

It was found that one major bottleneck in the rapid growth of the electronics industry and the extension of automatic control techniques in factories was the lack of appropriate enclosures which could be swiftly produced at low cost with quality consistent with delicate and expensive equipment.

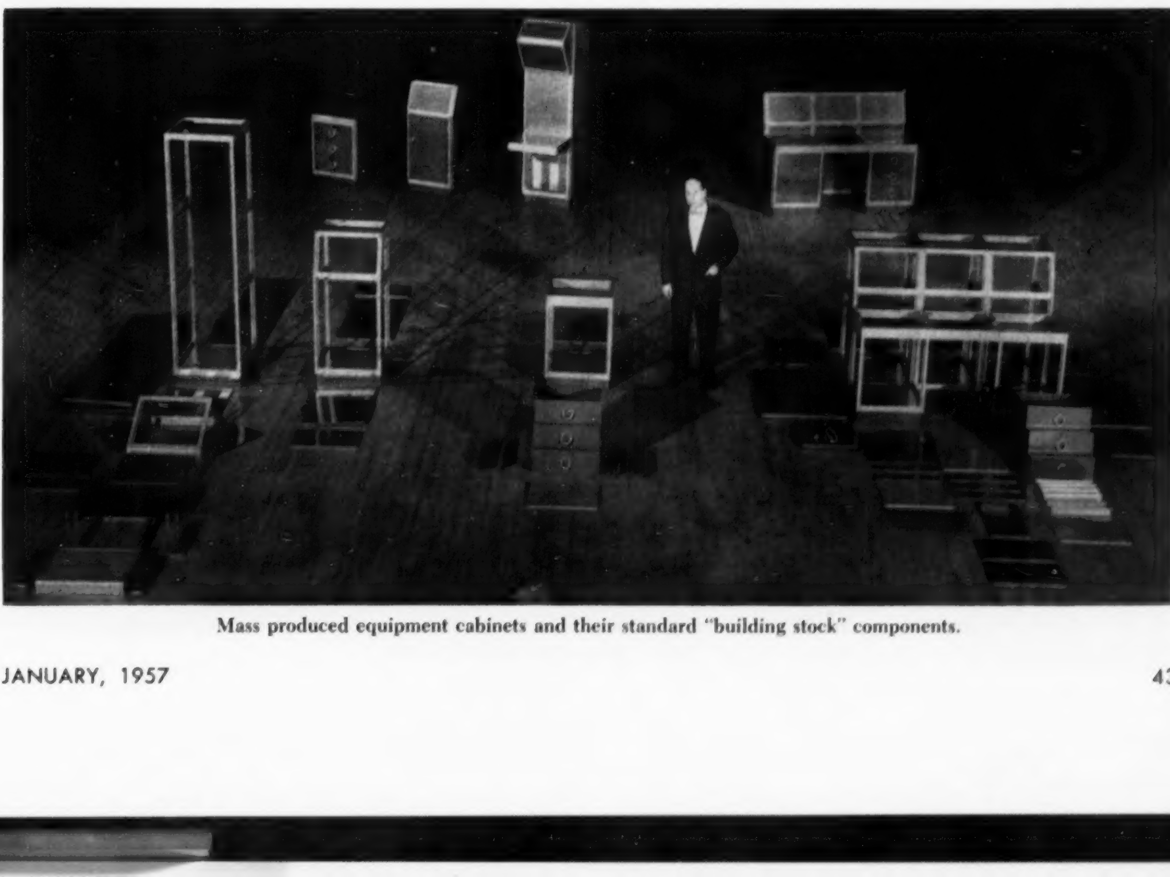
The answer is a veritable "engineer's Erector set" composed of mass-produced sub-parts. Finished cabinets in a wide variety of shapes and sizes can be constructed by screwing different sections to the basic steel framework. The frames, which may be assembled in combination, are designed to accommodate the 19-inch standard communications module.

One of the more elaborate consoles, factory sub-assembled from 30 component modules, sells for $600; a comparable custom-built model of the same type would cost over $1,500. The manufacturer reports that the standard line of modular cabinets will satisfy 75 per cent of the equipment enclosure needs of industry.

MICROFILM "WINDOWS" STREAMLINE SIGNAL CORPS PROCUREMENT PROGRAM

Microfilm "windows" in tabulating cards used for transmitting engineering drawings are expected to save upwards of half a million dollars annually in the Army Signal Corps procurement program. At Fort Monmouth, New Jersey, over 300,000 engineering drawings have been microfilmed. Positive film prints, made from the original microfilm negatives, are mounted in tabulating aperture cards which will be distributed to various Signal Corps installations throughout the world for reference in the repair of equipment and for procurement. They will also be used to make reduced-size paper prints to use for issuing bids to industry, replacing the old costly method of making full-sized paper reproductions of drawings.

In previous national emergencies, the procurement of new equipment for military communications was seriously handicapped by the delay in reproducing engineering drawings and getting the bids out to manufacturers. The new microfilm-aperture card system, will provide us with the means of cutting days and weeks off the time of getting contracts underway for new mili-



Mass produced equipment cabinets and their standard "building stock" components.

tary projects essential to our defense. At the same time, the aperture cards will keep repair depots up-to-date on all changes in the drawings of existing equipment. Where depots formerly had to get full-sized drawings from a central source, they can now produce the necessary copies from microfilm images on the spot.

Most Signal Corps drawings, some dating from World War I, have been converted to microfilm images the size of a match pad. Seven Recordak microfilm machines were used to photograph the drawings, reducing them in size by 16 and 29 diameters. Positive film prints were produced and mounted in Filmsort aperture cards. About five million cards will be needed to provide all the necessary duplicate sets.

At present, new drawings and changes in old ones average about 500 a week. These will be microfilmed and duplicate positive prints in aperture cards provided to installations on a regular monthly basis.

PORTABLE GARAGE PROTECTS AUTO

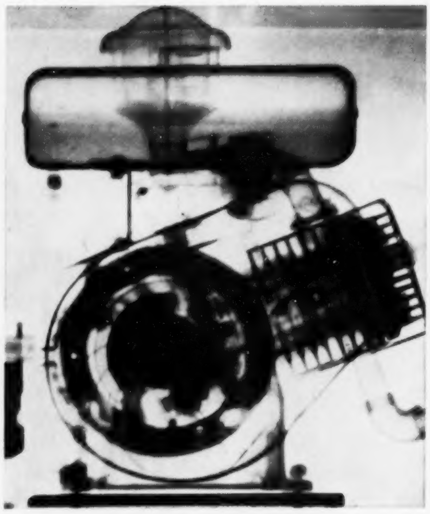
On-the-spot protection for automobiles against inclement weather, dust, and bugs is provided by portable "Rolla-Cloth." Garages are made from cotton coated on both sides with Du Pont "Alathon" polyethylene resin, resulting in a light, strong, waterproof material which is indestructible with normal use.

With a minimum of effort, the garage can be tossed lightly over the top of the auto and drawn closed with a laced-rope drawstring. The cloth, coated with "Alathon," provides a neat, form-fitting covering, does not become rigid in freezing weather, and will not stick to the paint on the car, even when wet.

Other recommended uses are as shelters for trucks, station wagons, farm implements, machinery, trailers, boats, furniture, and crops, or any product requiring protection from water and weather.

FIRST ENGINE X-RAY

A team of General Electric-Detroit Arsenal engineers has achieved the difficult feat of making motion pictures of the inside of an engine while it is running. The technique used, called *stroboradiography*, could have a significant effect on engineering design. Slow-motion X-ray movies and still pictures of pistons, cams, and other moving parts have enabled engineers to scrutinize complete cycles of engine operation for faulty performance or wear.



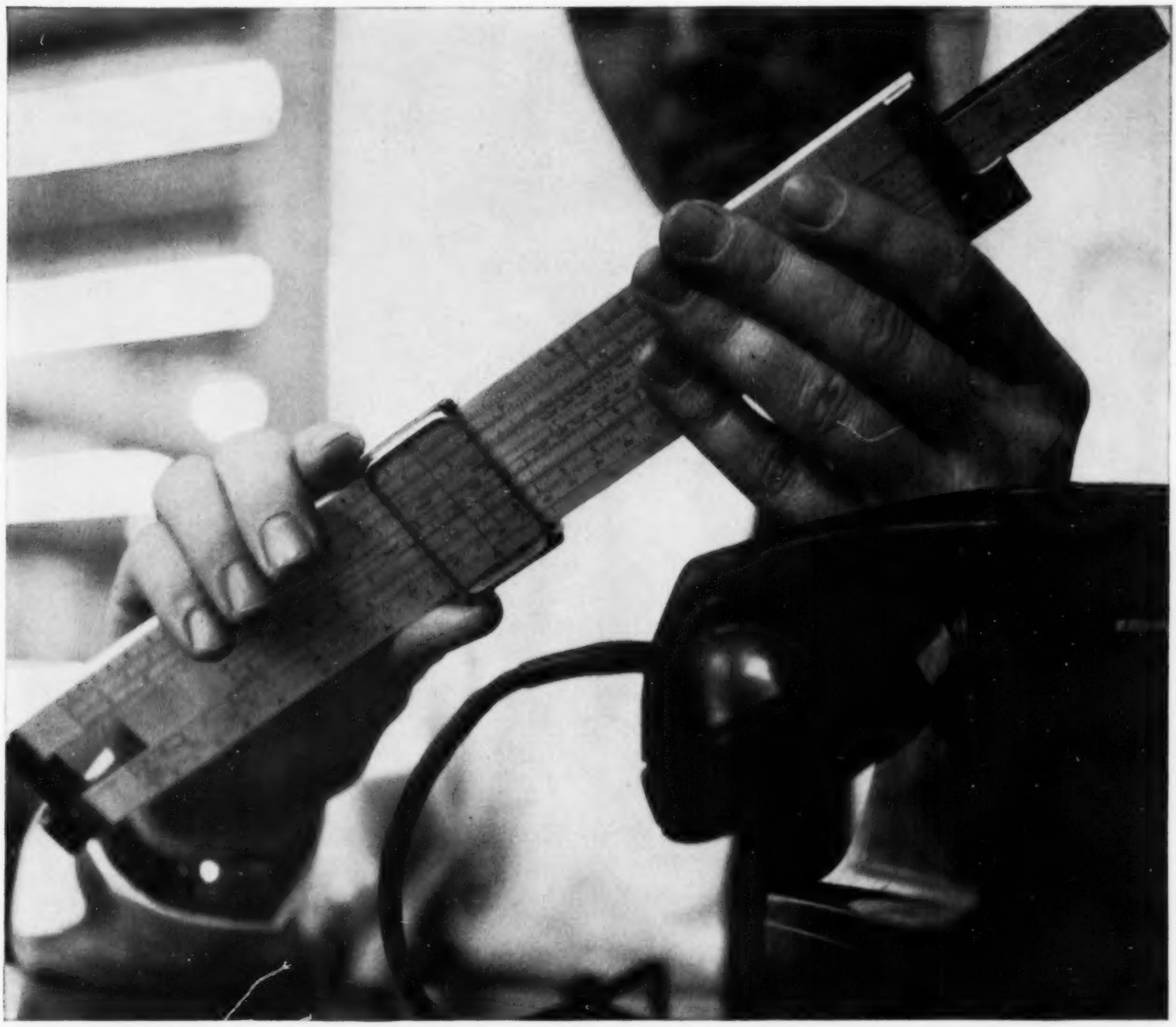
X-ray of running engine produced by new stroboradiographic technique using the General Electric 15 Mev betatron.

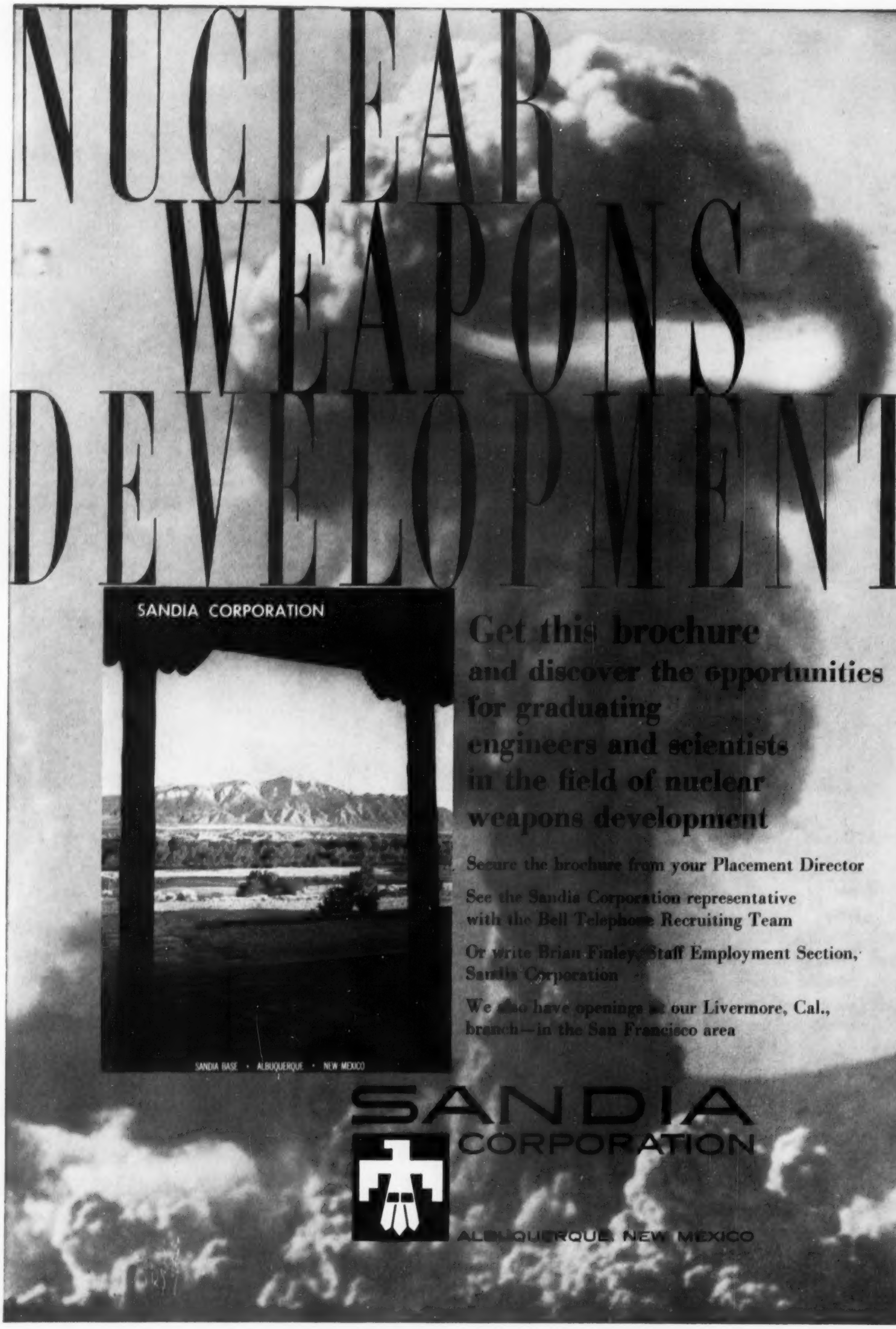
The revolutionary process gives designers their first glimpse inside a complete machine operating at normal speed under load conditions. Improved, lightweight designs and perhaps important basic design changes could result from X-ray studies.

The special stroboradiographic equipment was developed by General Electric for use with its high-energy industrial X-ray betatron, operating at 5 million to 15 million volts. Previously, single-shot exposures of moving objects had been made with low-energy equipment, but the quality of the radiographs suffered when the object was composed of heavy parts of varying thickness. The new process involves taking thousands of short exposures accurately synchronized with the moving part. With an exposure time of 10 to 15 millionths of a second, it is possible to radiograph an engine turning at several thousand revolutions a minute. The image is formed on a special film by repeated exposures. Slow-motion movies are obtained by splicing in sequence photographs of various points in the cycle of a piston.

(Continued on page 52)

Portable "garage" can be quickly thrown over automobile.





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Walter L. Hardy

"The objects of this Society are to promote the welfare of the College of Engineering at Cornell University, its graduates, and former students and to establish closer relationship between the college and the alumni."

THEORY, LAW AND SCIENTIFIC PROCESS

There should be no place for the liberal in science. Science, to be constructive and progressive, must be based on fact, postulated and then proven beyond a doubt. Science cannot be based on opinion or prejudice nor abused for anyone's purpose or advantage.

Unfortunately, the trend towards the ultra in liberalism is finding converts among many who were trained in the scientific disciplines. This is unfortunate and we should be constantly on guard against accepting opinion, expressed in word or writing, as scientific fact.

Acquire the inquisitive habit when listening or reading. Most important ask yourself why did the author do this work, what was he trying to prove and for what purpose. Was there an ulterior or selfish motive? "Figures don't lie," but you can use them to prove almost anything if you start with a preconceived result or objective. For example, what was Kinsey's purpose when he started with a relatively few facts from a restricted American sample and wrote two books on the sexual relations of the whole human race?

Theories are a part of the scientific process. Based on experience, postulation and the use of scientific methods theories are developed, but never lose sight of the fact that they are theories and not scientifically proven. Once proven, theories become laws—additional cornerstones on which build a greater technology. Einstein's theory on conversion of matter to energy ($E = mc^2$) has certainly been proven and can be considered an irrefutable law. Similarly, his theory of relativity has been subjected to quantitative verification and can be assumed to be a law. However, Darwin's theory of evolution is still a theory and has little or no quantitative proof up to the present time. To teach and illustrate this theory for more than it is—a postulation—is an abrogation of the scientific process.

In the commercial world, science and scientists are often perverted for competitive advantage. Watch for the actor, costumed as a doctor or scientist, treading upon your professional standing while making a pseudo-scientific pitch without facts. Note the newspaper which carries on a campaign against a product or industry—but observe as well the amount of advertising copy they carry for that product or industry.

Observe, check, verify and always ask why. For example, what was my motive in writing this?

Walter L. Hardy

ALUMNI ENGINEERS

J. Bradley Cooper, MEE '25, is supervisor, Engineering Administration, General Electric Co., Pittsfield, Mass. He is the author of several technical papers including a distribution transformer maintenance manual. Bradley served as Lt. Col. in the Signal Corps during World War II. He is deputy director, Civil Defense Department, City of Pittsfield.

Philip M. Sherman, EP '52, 429 George Street, New Haven 11, Conn., is an electrical engineer and a graduate student at Yale University. He began work on the PhD last fall.

William D. Hamilton, ME '31, '32, 2945 Fairfax Road, Cleveland 18, Ohio, has been appointed vice-president of coal operations of Oglebay, Norton & Co., Cleveland iron ore, coal, and shipping firm. He was formerly coal mines manager for the company.

Professor **George Winter, PhD '40,** Structural Engineering, was honored at a luncheon at the Savoy Hotel in London, December 6, given by the Cold Rolled Sections Association and addressed the Association that evening on American developments in light-gage steel. During his sabbatic leave in Europe, he will also lecture at the Royal Technical College of Scotland on structural research at Cornell.

Ronald E. Jorasch, EE '56, son of Mr. and Mrs. Emil Jorasch of 16511 Maple Heights Boulevard, Maple Heights, Ohio, will study engineering at the University of Sydney in Australia. He received a bachelor of electrical engineering degree at Cornell in June.

John S. Priedeman, CE '56, of Asheville, N.C. has been awarded the first Cornell Aeronautical Laboratory Fellowship. The fellowship is given to those who wish to pursue advanced study in the Graduate School of Business and Public Administration.

Walter L. Hardy, ChemE '38, is president of the Cornell Society of Engineers and a member of the F. H. Rhodes Endowment Fund committee for the School of Chemical Engineering. He writes that we can count on him to be back for Reunion next June.

Chester T. Reed, ME '03, resigned last May after twenty-six years as president of Reed & Prince Manufacturing Co., Worcester, Mass., where he lives at 354 Salisbury Street. He joined the company in 1903 as a mechanical draftsman; was secretary from 1903-20 and vice-president from 1920-30. He continues as a director and an adviser.

William L. Mulroy, ME '05, is an engineer and lives at 404 Arthur Street, Syracuse.

Arthur L. Fuller, ME '05, retired in 1951 after twenty-seven years with Eastern Underwriters Inspection Bureau of Boston, Mass. He now lives in Newfane, Vt.

Walter H. Evans, ME '06, is a retired railroad executive and lives at 253 Wayne Avenue, Oakland 6, Calif.

Robert W. Jorgensen, ME '29, 555 Walnut, Winnetka, Ill., is vice-president of The Richardson Co., manufacturers of plastics. He is married and has four children, Brian, Jill, Deirdre, and Meade, who was born January 19, 1956.

Anthony W. Ferrara, AB '46, lives at 41-15 Fiftieth Avenue, Long Island City. He is an assistant mechanical engineer with the New York City engineering firm of Abbott, Merkt & Co.

John D. Lewis, ChemE '48, is a project engineer with Hydrocarbon Research, Inc. His address is 89 Park Place, Watchung, N.J.

Joseph C. Pursglove, Jr., CE '30, is president of Mountaineer Carbon Co., which was formed recently by Standard Oil Co. of Ohio and Pittsburgh Consolidation Coal Co. The new company will operate a carbon calcining plant at Cresap, W.Va., about twenty-five miles south of Wheeling. Since 1947, Pursglove has been vice-president in charge of research and development of Pittsburgh Consolidation Coal Co. His address is 520 Irwin Drive, Edgeworth, Sewickley, Pa.

Nathan W. Dougherty, MCE '13, retired this fall as dean of the college of engineering at University of Tennessee. Nathan is primarily a University of Tennessee man, Class of '09, where he was a football star and a track athlete. His shot put record remained unbroken until the early '30s. But, he did spend four years at Cornell in graduate work, and is listed as a '13er in our Class roster. Nathan helped organize the Southern Conference in 1921 and was the first secretary-treasurer of the organization, a member of its executive committee and its president in 1929. He was vice-president of the National Collegiate Athletic Association twice and a member of the executive committee for a number of years. At the present time, he is secretary-treasurer of the Southeastern Conference, which he helped organize in 1932. When at Cornell, he met **Agnes Monteith '14** and they were married in 1913. They have five children, two sons and three daughters, and now can muster 15 grandchildren. A mighty fine record, any way you figure it.

Roy E. Pratt, CE '21, of 122 Childs St., Springville, is a consulting engineer on the New York State Thruway.

Harry G. Burd, ME (EE) '09, former president of the Superior Wire and Cable Company of Hickory, North Carolina, has been appointed special consultant to the Sequoia Process Corporation for its telephone cable manufacturing, the company announced today.

Mr. Burd, whose experience in cable manufacturing dates back to 1910, will assist the company in all phases of its new telephone cable operations, including production, sales, and engineering.

Mr. Burd participated in the initial studies that led to Sequoia Process's decision to expand into the telephone cable market, and he also assisted the company on an advisory basis during the initial phases of its manufacturing this year. Sequoia's plant is the first on the west coast specializing in the manufacture of plastic-insulated telephone cable.

Mr. Burd is now living with his wife at 4231 Dake Street in Palo Alto, California.

James H. Sams, EE '24, dean of engineering Clemson College, Clemson, South Carolina, has been nominated as one of the eight regional vice presidents of ASME, Region IV.

Charles Peek, ME '49, works for Pratt & Whitney Aircraft in East Hartford, Conn. The September issue of The Power Plant, that company's house organ, has a picture of Charlie and the news that he has been promoted to assistant project engineer. The picture shows an astute individual seated at a desk piled high with reports.

Walt Addicks, ME '14, has his own particular chair for lunch at the Engineers Club in New York; the whole club membership sees to it that it is kept inviolate for Walt.

TECHNIBRIEFS

(Continued from page 44)

CAL HIGH TEMPERATURE WORK

The extremely high temperatures encountered by jet aircraft flying well beyond the speed of sound have become a serious problem for aircraft manufacturers and researchers. Modern high performance jet aircraft are reaching speeds at which air friction on an airplane's surfaces produces high temperatures which, combined with the stresses of high speed flight, cause conventional metals to gradually lose their shape. This phenomenon, referred to as "creep," not only limits performance, but can destroy an airplane.

Intense research is currently underway to develop metal alloys capable of withstanding creep. Cornell Aeronautical Laboratory, Inc. of Buffalo, N.Y., has developed an important system for precision testing these new alloys. Basically, the CAL metal testing technique simulates the temperatures, stresses and strains experienced by metals under actual flight conditions. The system produces more accurate data than conventional metal testing methods and is believed to be the only successful flight simulation technique in use. The CAL testing system subjects metals and alloys to periodic fluctuations of temperature, stress, and strain. By changing a metal's environment in this manner, the system produces conditions similar to those experienced by the metal when used on supersonic aircraft during flight.

The CAL materials department, which has been active in metallurgical research for eight years under contracts with the Department of Defense, has employed its unique system to test several recently developed heat-resistant alloys. Tests have been conducted at the Laboratory on metals ranging from aluminum to super-alloys of the chrome, cobalt and nickel variety.


IT'S ENOUGH TO MAKE YOUR
BLOOD BOIL
The jet speedway, that outer envelope of air 10 to 15 miles above the earth, could be a chamber of death to today's pilots because of the lack of air density. If the pilot were not protected by ingenious accessories to provide an artificial climate, his blood would bubble like fizz water. Advanced, space-conquering equipment such as these air conditioning units are now being produced by Hamilton Standard for America's most modern aircraft. It is a dynamic, exhilarating engineering environment where the accent is on tomorrow.
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FACULTY PROFILE

(Continued from page 32)

ent that day. While he had previously had little interest in politics, he came then to realize its importance.

What had previously been only an interesting problem for scientific inquiry, had suddenly exploded into a force which was to change the course of history. Perhaps he felt some responsibility; whatever the reason, he began to work actively to educate the public about the dangers of the bomb through political associations formed among scientists. He helped found the Federation of Atomic Scientists in 1945-46, and served as its president in 1946. This group warned repeatedly that the United States could not expect to have a monopoly on the bomb indefinitely and even correctly predicted when the Russians would make the bomb. The group is perhaps best known today by the *Bulletin of the Atomic Scientists,* published by the Chicago chapter.

Following the war, he wished to return to the combined teaching and research activities in which he had been engaged before the war. He taught for a year at Harvard, and then accepted Cornell's offer to become the head of its expanding nuclear studies program in 1947. Although originally housed in Rockefeller Hall, in which the Cornell cyclotron was built in 1936, the Laboratory of Nuclear Studies moved into its new quarters north of Savage Hall in the spring of 1948. During his first years here, much of Dr. Wilson's time was spent in supervising the construction of a 300 Mev. synchrotron, which was completed in 1949. Later, when this energy was felt to be insufficient, he designed a new 1.5 Bev. synchrotron, believed to be the biggest in existence, which was completed in 1953 with the help of a two hundred eighty million dollar appropriation from the

(Continued on page 56)

Navy. Dr. Wilson, who has participated in the research carried on with these two machines, is primarily interested in the meson, an elementary charged particle having a mass about two hundred seventy times that of an electron. It is believed to have something to do with the mysterious forces which hold the nucleus together. Mesons, which have been produced from nuclei by the bombardment of high energy gamma rays, such as from cyclotrons and synchrotrons, were first discovered in the earth's atmosphere, where they are produced by incoming cosmic rays and last, on the average, only about two millionths of a second.

Although the laboratory concerns itself somewhat with a few biological and chemical applications of its findings, such as tracer studies, its primary aim is to investigate the particles of which the nucleus is composed and to discover more about the forces which hold these particles together. Most of these nuclear particles have been discovered by studying cosmic rays; now, although there are still higher energies to be found among cosmic rays, most new particles are found by the use of accelerators. The principal problem now with cosmic rays is their origin—a field in which a Cornell physicist, Dr. Philip Morrison, is active. The laboratory has contributed to cosmic ray research by sending expeditions to the top of Mt. Evans in Colorado and into the local salt mines. In addition to these research activities, the laboratory has some thirty graduate students working under its direction.

Along with his other varied duties, Dr. Wilson is also a teacher, instructing a course in advanced nuclear physics. Last year he spent his sabbatical leave in Paris as an exchange professor at the *Sorbonne,* where he taught the nuclear physics of mesons. The most amazing part of this was that he knew no French before he left beyond that offered in French 101. He was able to continue his research, this time in low energy nuclear physics at the *Collège de France.*

Although he is far from the highest paid executive, Dr. Wilson is doing work which he enjoys and which utilizes his versatile talents.

These two criteria, often cited as the basis of happiness by psychologists, have certainly contributed to Dr. Wilson's happiness, together with a sense of accomplishment as a member of a team engaged in one of the most important human endeavors.

COLLEGE NEWS

(Continued from page 35)

Telephone Laboratories, in collaboration with the faculties of the applicants' schools.

Mr. Peterson, 25, of Johnstown, Colo., received his B.S. degree from Colorado A. & M. College in 1953 and his M.S. in engineering mechanics from Cornell University in February, 1956. He expects to use his fellowship at Cornell to further his study in vibrations and wave propagation.

CORNELLIANS WIN LINCOLN AWARDS

Several Cornell Students have won awards from the James F. Lincoln Arc Welding Foundation of Cleveland, Ohio, in its undergraduate mechanical and structural design competition.

In the mechanical division, James N. Perry, ME, and Robert W. Brandt, ME, won second prize of $250 for their paper, "The Palletoter—A Low Lift Pallet Truck Design." John H. Bvettner, ME, received a fifth prize of $50 for his paper on "A Universal Transfer Machine."

In the structural division, Henry Shing-Yi Ma, CE, Richard Wildman, CE, and Barry Elgort, CE, won a sixth prize award of $25 for their paper on a "Welded Cantilever Aircraft Hanger."

IBM GIVES ARCHITECTURE GRANT

The International Business Machines Corporation has made a grant of $6,000 to the Department of City and Regional Planning in Cornell's College of Architecture, the university announced.

One of the department's teams of graduate students, who do research each year in cities and towns, will work this year in Owego, N.Y., where IBM is building a large new plant for its Airborne Computer Laboratories.

Dean Thomas W. Mackesey of the College of Architecture announcing the grant, explained that it reflects the company's interest in living conditions and community facilities in the areas about its plants.

(Continued on page 60)

Mulling Over these Questions about your First Job?

Check Republic Aviation's Answers

Will the company I choose boost my professional reputation?

A REPUBLIC has been pioneering new concepts in aircraft design for over 25 years. Our present production plane is the most advanced fighter-bomber in the U. S. Air Force—the incredible F-105 Thunderchief. Our Guided Missiles Division is investigating the upper atmosphere and advanced satellite problems; and have created the first portable, inexpensive rocket, Terrapin.

Are the assignments interesting?

A Our engineers are working ten years ahead . . . which means that every project you're assigned to is at a research or developmental level. And you get a crack at responsible assignments from the start . . . modern facilities to test out your ideas . . . with engineering aides to do the routine work.

Are there good men on the team?

A Well — for one — there's Alexander Kartveli, Vice President, Research & Development, who sparked the Thundercraft series. There's Dr. Theodore Theodorsen, for another — among whose accomplishments is the theory of wing-flutter — who heads our Scientific Research Group . . . and there are hundreds of other engineers and scientists of major stature.

Does the location suit a modern way of life?

A You'll live on Long Island with its fabulous beaches and parks — less than an hour from New York City's cultural and entertainment facilities . . . giving a man the best combination for a well-rounded life...and enough money to enjoy it — coupled with a benefit program that's a model for the industry.

Can I make a name for myself?

A Only you can answer that . . . and your talent is the key. But everything that is possible for a company to do — for you to achieve your maximum potential — REPUBLIC does . . . including attendance and presentation of papers at professional meetings and advanced studies at prominent universities and colleges.

To find out all about our brand new and unique training program see the Republic man when he visits your campus. Make an appointment now with your placement director.

or you may address your inquiries to:

Mr. George R. Hickman
Engineering Employment Manager
Farmingdale, Long Island, New York

REPUBLIC AVIATION

COLLEGE NEWS

(Continued from page 57)

Cornell will use part of the grant for a graduate fellowship in city planning, and has awarded the 1956-57 fellowship to David W. Cronin of Dublin, Ireland. He is a graduate in architecture from the National University of Ireland and a barrister-at-law from King's Inns, Dublin.

STUDENTS WIN ANNUAL PRIZES

Cornell engineering students who have won annual prizes and awards have been announced by the College of Engineering.

Winners are listed, according to the divisions of the college with the year they will complete Cornell's five-year engineering course:

College of Engineering

Fuertes Memorial Prizes in Public Speaking—first prize of $80 to John L. Haynes Jr. EE '56. Second prize of $50 to John W. Hyman CE '56. Third prize of $25 to James N. Perry ME '56. Prizes of $10 each to John D. Baldeschweiler ChE '56, Paul Bradley ChE '56, and Robinson Ord Jr. ChE '56.

John L. Haynes also won the American Institute of Electrical Engineers Award by placing first in the Ithaca section's paper contest, and competed in the AIEE northeast district contest.

Silent Hoist and Crane Company Materials Handling Prizes, established by the Wunsch Foundation, for original papers—first prize of $125 to Salah E. A. Elmaghraby, graduate student in Mechanical engineering, for a paper on "Design Criteria for Conveyor Systems." Second prize of $75 divided between John D. Douglass Jr. EE '58 and John W. Nostrand Jr. ME '58, for their paper on "The Handling of Cherries."

School of Chemical and Metallurgical Engineering

American Institute of Chemical Engineers Prize—Brinton Deighton Jr. '58.

School of Civil Engineering

Fuertes Medal for the senior with highest grades—John Priedeman '56.

Charles Lee Crandall Prizes to seniors and juniors for the best papers—first prize of $75 to Robert J. Strohl '56; second prize of $50 to Leonard Pisnoy '57.

American Society of Civil Engineers Junior Membership Award—Damon G. Douglas Jr. '56.

School of Electrical Engineering

Sibley Prizes in Electrical Engineering of $25 each for fifth-year students with the highest averages—Irwin M. Jacobs '56, and Rodney S. Rougelot '56.

American Institute of Electrical Engineers Award—John L. Haynes '56.

Institute of Radio Engineers Outstanding Student Award (New England Radio Electronics Meeting)—Hugh Paul Janes Jr. '56.

Eta Kappa Nu Award—Arthur R. Kraemer '59.

Institute of Radio Engineers Award—William R. Laidlaw '56.

School of Mechanical Engineering

American Society of Mechanical Engineers Awards—Barry J. Dyer '57; a tie between Edward K. Barnard '57 and Morton N. Rochman '56.

Sibley Prizes in Mechanical Engineering of $25 each for fifth-year students with the highest averages—Thomas C. Reed '56 and Alfred W. Mitchell '56.

RESLER APPOINTED TO AERONAUTICAL ENGINEERING STAFF

Edwin L. Resler Jr. of the University of Maryland has been appointed an associate professor of aeronautical engineering.

At Cornell he will be in charge of the Gasdynamics Laboratory of the Graduate School of Aeronautical Engineering and will teach courses in gasdynamics, aerodynamics and thermodynamics.

As associate research professor, since 1952, in Maryland's Institute for Fluid Dynamics and Applied Mathematics, Professor Resler has directed work in fluid dynamics.

He has also been chief investigator in research on the properties of air and other gases at high temperatures, and their application to hypersonic flight.

He serves on the fluid mechanics subcommittee of the National Advisory Committee for Aeronautics, and is a consultant for the Diamond Ordnance Fuse Laboratories, and the research laboratory of Avco's Advanced Development Division.

A native of Pittsburgh, Professor Resler attended Navy programs at Bethany College and Notre Dame University. He was the assistant engineering officer in the Naval Air Reserve Training Unit at the Miami Naval Air Station.

Returning to Notre Dame, he graduated in 1947 and then received his Ph.D. at Cornell's Graduate School of Aeronautical Engineering in 1951. In the following year he carried on research at Cornell and taught two courses in the school.

DALMAN APPOINTED TO EE FACULTY

G. Conrad Dalman of the Sperry Gyroscope Company in Great Neck, N.Y. has been named a professor of electrical engineering at Cornell University.

Professor Dalman will teach courses and conduct research in his special field of electron tubes and associated circuitry.

After receiving a bachelor's degree in electrical engineering in 1940 at the City College of New York, Professor Dalman was associated successively with the R.C.A. Victor Division and Bell Telephone Laboratories, working chiefly on developing electronic tubes.

He received master's and doctor's degrees at the Polytechnic Institute of Brooklyn in 1947 and 1949, and has since then been with Sperry Gyroscope.

His work there has been on microwave tubes and on oscillator studies. Since 1954, he has been engineering section head in the company's tube department. He has also taught evening courses at C.C.N.Y. and Brooklyn Polytech.

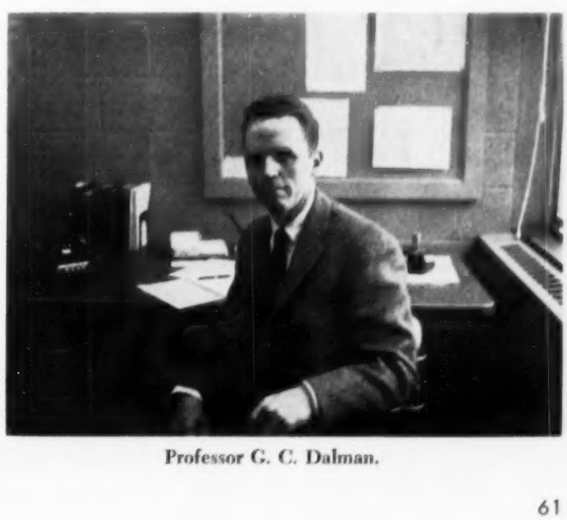
SURVEY CAMP USES COMPUTER

Automation made life easier for Cornell students in this year's Summer Survey Camp.

In previous camps, students computed far into the nights on their

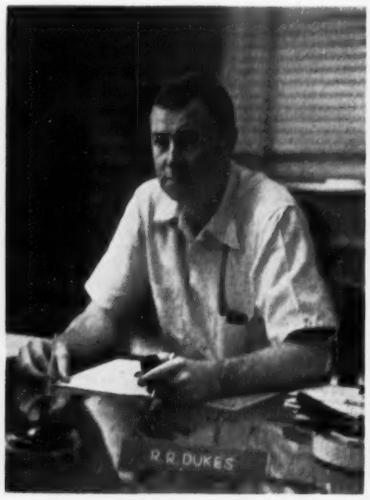
(Continued on page 67)

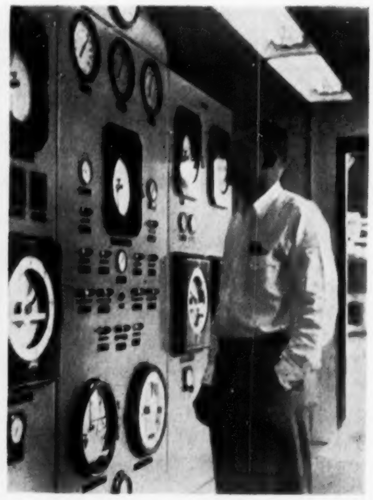
Professor E. L. Resler, Jr.



Professor G. C. Dalman.

Rapid advancement is typical at Pennsalt Chemicals



Bob's responsibility as supervisor of chlor-caustic production at the Pennsalt Calvert City plant involves regular inspection of equipment and controls, close planning of production, and field trips to check on product quality.

Take Bob Dukes for example. With his B. S. degree in Chemical Engineering from the University of Delaware, Bob started as a Pennsalt student trainee in July 1950. As soon as his training program was finished, he was assigned as Junior Chemical Engineer on our Philadelphia staff. And then . . .

. . . Bob Dukes quickly found that Pennsalt, though one of the most important large chemical organizations, wasn't so big that his talents were lost in the shuffle. From Junior Chemical Engineer in Philadelphia, Bob was promoted to our new Calvert City (Ky.) chlor-caustic plant as assistant to the head field engineer. Then in rapid succession came two advancements to his present responsible position as head of the entire chlor-caustic production process at Calvert City.

OPPORTUNITIES FOR THE IMAGINATIVE

To meet the needs of a tremendous expansion program, Pennsalt seeks other imaginative, able men like Bob Dukes—men with a desire to learn . . . men with the ability to apply book-learning and job-learning to new challenging problems . . . men who will contribute new thought to the organic and inorganic interhalogen research program that has already made Pennsalt famous. To attract the type of men we need, and to encourage work towards graduate degrees and professional distinction, we offer a working and living climate hard to beat in this fastest-growing industry of all—modern chemicals.

YOUR INTERESTS AND AMBITIONS

If your degree is in chemistry or in chemical engineering, there are 40 ways in which you may fit in at Pennsalt, in departments as diverse as product development, engineering, research, production, sales, and finance. If your ideas about rapid advancement in your work coincide with ours, send for the new booklet that tells the whole story about careers with Pennsalt Chemicals.

Address your request to Executive Procurement Director
Pennsalt Chemicals
Three Penn Center Plaza
Philadelphia 2, Pa.

Pennsalt Chemicals


Alexander the Great, who, before he was 30 conquered almost all the known world, was history's hardiest character. Schooled by Aristotle, conditioned to endure unbelievable extremes of cold, heat, hunger and thirst, Alexander, though always outnumbered in battle, always triumphed.

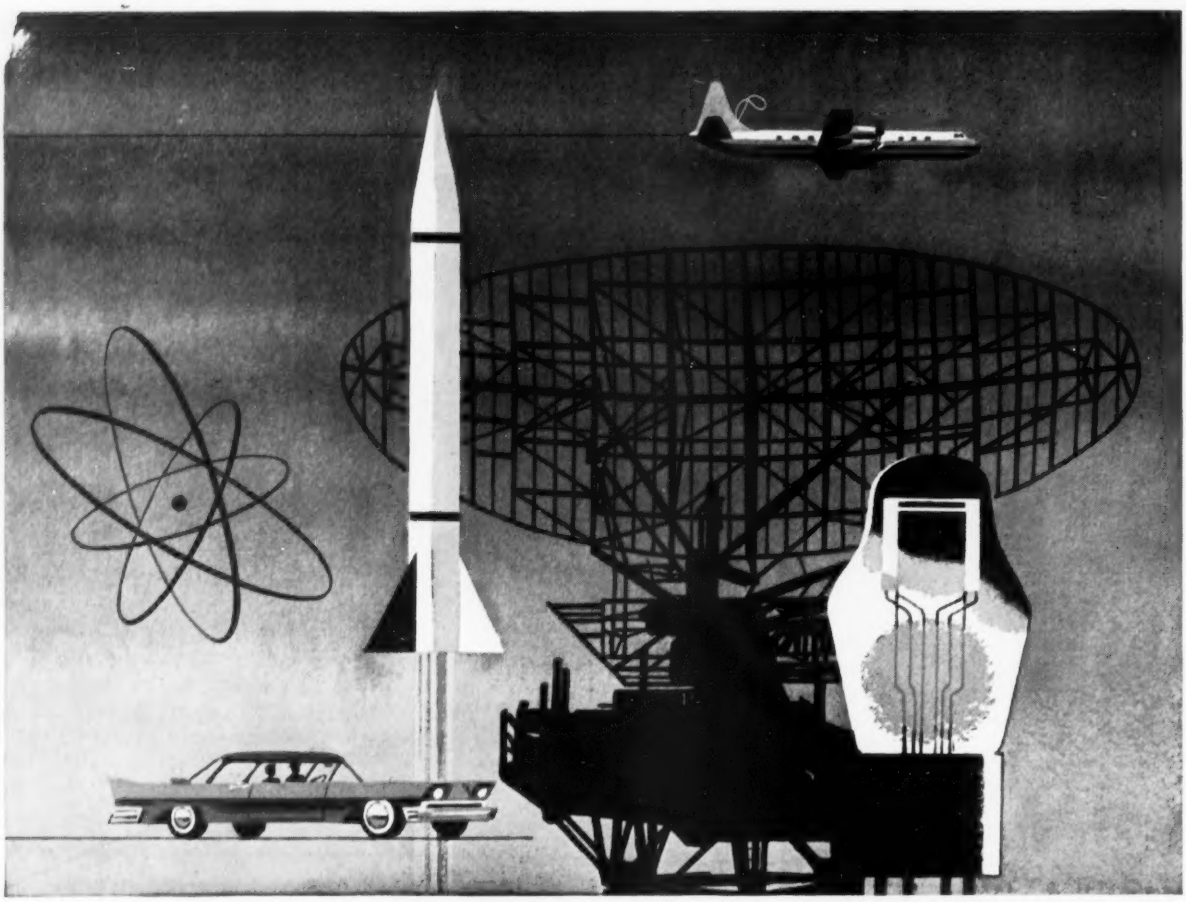
CABLES

(Continued from page 18)

is laid in water about a mile deep. The two cables have three repeaters each. This cable was laid as a prototype for the transatlantic telephone cable. In October, 1954, the British laid a cable between Bergen, Norway and Aberdeen, Scotland. This was 300 miles long and used seven two way repeaters. Since it was laid in water less than one quarter of a mile deep, it contributed greatly to the development of shallow water cable. In the summer of 1955, the Alaska telephone cable was laid between Port Angeles, Washington and Ketchikan, Alaska, west of the Canadian Ilse. This cable had one way repeaters, thereby necessitating the use of two cables. The Alaska cables have thirty-nine repeaters, nineteen in the cable closest to land and twenty in the other. The cable is about 750 miles long and cost about $15,000,000. It is being used to supplement the fifteen land and radio lines previously constructed between the United States and Alaska.

In 1956, the transatlantic telephone cable was finally laid, being officially opened on September 25. It had been planned for about twenty-five years. The cable is a joint project of the American Telephone and Telegraph Company, the British Post Office, and the Canadian Overseas Telecommunication Corporation, costing about $42,000,000. The system consists of two cables laid twenty miles apart from Oban, Scotland to Clarenville, Newfoundland, a distance of 1950 nautical miles or 2250 statute miles. There are 104 repeaters used in it—fifty-two in each cable. They are spaced about forty miles apart. The cable has a thirty-six channel capacity, and it has the widest bandwidth yet built in a cable of this type, however, it is not wide enough for television. At the terminals, 2000 volts are fed into the cables with a negative and positive potential totaling 4000 volts. The HTMS Monarch laid the cable. Although this ship is only two-thirds as long and has less than half the tonnage of the "Great Eastern," it has an equal cable capacity and cable laying speed. Connecting the cable from Newfoundland to Nova Scotia on the mainland is a single cable of British design with sixteen two way repeaters. These repeaters are rigidly housed in a forged steel case nine feet long and ten and one-half inches in diameter. The whole repeater weighs three-quarters of a ton.

These submarine cables are a vital and necessary part of our communications system. Radio wave communications is restricted by its spectrum which limits the number of circuits that can be provided, and also by magnetic storms that periodically hinder their transmission. Cables have neither of these problems and they also have the added advantage of being immune to interception. This is necessary to the government in sending military or defense secrets. Cables are, therefore, not a step backwards in the development of electronic communications, but an important and reliable supplement to the air waves.



COLLEGE NEWS

(Continued from page 61)

own non-electronic brains. Now data gathered in the field during the day goes to the Cornell Computing Center for processing.

Prof. Arthur J. McNair, camp director, says the men have enough hand computing to learn how to do it. But 10 years from now, he predicts, they will have more need to know how to use computing machines.

The summer camp is required for every student in the School of Civil Engineering. Fifty-five students were in this year's camp, August 13 to September 15, on Cayuta Lake, 22 miles west of Ithaca.

The students made precise measurements of all types—soundings of the lake, topographical surveys of the surrounding area, route surveying for a proposed highway cutoff, and astronomical observations.

Cornell, in 1874, had the first university survey camp in the nation. Since then students have mapped seven of the Finger Lakes—Cayuga, Cayuta, Keuka, Otisco, Owasco, Seneca and Skaneateles. Their work had been used in maps published by the U.S. Geological Survey and the U.S. Bureau of Fisheries.

Photo Credits

Frontice, AT&T; Page 16, AT&T; Page 17, AT&T; Page 18, AT&T; Page 24, top, Life; bottom, Life; Page 25, top, Life; bottom left, Life; right, Life; Page 43, Elgin Metal-formers Corp.; Page 44, top, G.E.; bottom, Dupont.

NATURAL GAS

(Continued from page 26)

ent types of fuel such as liquid propane gas (bottle gas).

One of the biggest problems confronting the industry is the seasonal variation in use. In summer, gas consumption drops, particularly in the home, and during the cold winter months, it zooms. Yet an efficient, dependable gas system must be able to meet capacity loads at all times. It costs almost as much to transmit a small amount of gas in a pipeline as it does to carry a capacity load.

One way it has met the problem is through the sale of gas to industries on an interruptible basis.

Already the gas industry has spent more than $375 million on storage projects with 167 underground storage reservoirs in 17 states now being used and 12 more under construction.

YOUNG MAN

...going to put roots down!

Once you have shed the cocoon of college curricula, where and how you will live becomes as important as where and how you will work.

To those of you thinking about operation job hunt, Public Service Electric and Gas Company has a story to tell.

The Company — one of the country's greatest utilities — serves a compact area of New Jersey, with New York and the Hudson on the north and Philadelphia and the Delaware on the south.

This bit of territory offers much to the young men when, as, and if considering home and family—where they should live and how. It is in the heart of the world's largest concentration of purchasing power; it has the widest diversification of interests — economic and social — of any area of its size in the country.

Replete with Americana, this service area of ours has cultural, educational, and recreational advantages second to no other. A large portion of the world's research activities are conducted here.

Whatever it is you want for yourself and family, New Jersey has it.

At some time during the college year, representatives of the Company will visit your campus. Make it your business to talk with them. They have an interesting opportunity story to tell.

In the meantime, use the coupon for literature on "You, a Job, and New Jersey".

• • •

Public Service Electric and Gas Company,
Room 2152A, 80 Park Place, Newark 1, N. J.

Please send me literature on New Jersey and job opportunities with Public Service.

Name..

Address..

....

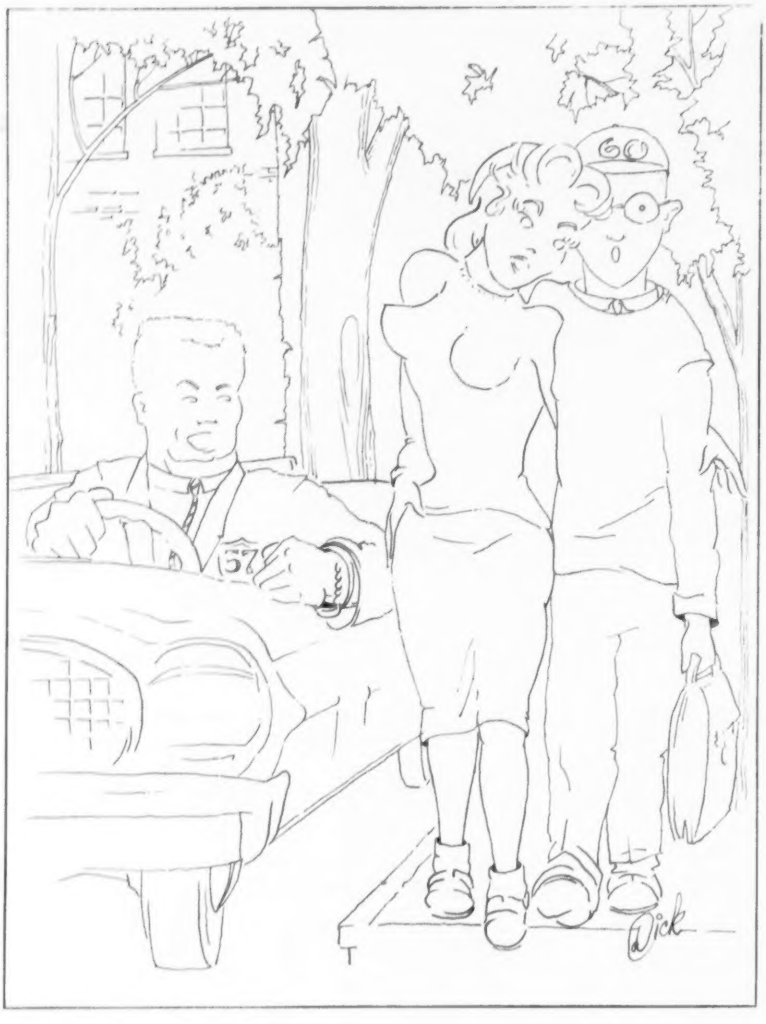
College..

A-2-57

PUBLIC SERVICE ELECTRIC AND GAS COMPANY, NEWARK 1, N. J.

STRESS *and* STRAIN . . .

IT COULD HAPPEN HERE . . .
but it's Doubtful



Golf is a game in which a ball 1½ inches in diameter is placed on another ball 8,000 miles in diameter. The object is to hit the small ball, but not the large one.

° ° °

The professor grimly eyed the class as he prepared to return a batch of examination papers. "You will remain seated while they are passed out," he commanded. "If you were to stand, it is conceivable that you might accidentally form circle. That would make me liable for arrest."

"Why?" the kids asked.

"I could be arrested for maintaining a dope ring!"

° ° °

A Communist agitator rode into a city park, and after leaning his bicycle against the railing, mounted a soap box and addressed the crowd.

"If your family is hungry," he shouted, "raid a shop and take food for them, and don't care what anybody says. If your wife hasn't a coat, take the best fur coat you can see, and ignore the consequences."

After several more minutes in this type of talk, he dismounted from the soap box, and his next words were, "Where's the scoundrel who took my bicycle?"

° ° °

Sweet young thing: "Now, what are you stopping for?"

M.E.: "I've lost my bearings."

She: "Well, at least you're original, most fellows run out of gas."

° ° °

You know what the once over is?
That's this!
when like
you girl
look at a pretty

° ° °

Book Salesman: "Young man, you need this book, it will do half your college work for you."

Engineer: "Fine, give me two of them."

° ° °

I didn't want to marry her for her money, but I didn't know how else to get it.

° ° °

A motorist was picked up unconscious after a smash and was being carried to a nearby filling station. Opening his eyes en route, he began to kick and struggle desperately to get away. Afterward he explained that the first thing he saw was a "Shell" sign, and "some damn fool was standing in front of the 'S' ".

° ° °

Research Division: Liquor Test

Connect 20,000 volts across a pint. If the current jumps it, the product is poor. If the current causes a precipitation of lye, tin, arsenic, iron, slag, and alum, the whiskey is fair. If the liquor chases the current back to the generator–You've got good whiskey.

° ° °

And as they say in Mechanics–"Every couple has its moment."

° ° °

C.E.: "I have here the one and only cure for dandruff."

Date: "Really, how does it work?"

C.E.: "Oh, it's really simple–it's a mixture of alcohol and sand."

Date: "But, how does it cure dandruff?"

C.E.: "Well, you just rub the mixture on your hair; then the bugs get drunk and kill each other in a rock fight."

DESIGNING COMPLETE PLANT LAYOUT for a new manufacturing activity are Howard Jenkins, Maine '50, and Dick Rayve, Brooklyn Polytechnic '54. This manufacturing engineering problem involves operation planning, materials handling, and designing machine tools.

EXTENSIVE ENGINEERING INSIGHT and a firm knowledge of manufacturing problems guide Tom Robinson, Alabama Polytechnic Institute '54, in purchasing materials for operating departments. Tom, at left, discusses possible application of metal products with vendors.

AT GENERAL ELECTRIC . . .

Your engineering background fits you for expanding opportunities in manufacturing

Today's engineers are going to work in manufacturing—and rightly so. The products of our rapidly advancing technology—involving mechanical, electrical, hydraulic, chemical and electronic components—call for greater engineering skill in their production. With the advent of atomic devices there will be an even greater demand for engineering knowledge in the manufacturing function.

General Electric, long a leader in modern manufacturing methods, is currently planning expansions and improvements to double its production rate in the next ten years. To meet this intensified demand, the Company has instituted a Manufacturing Training Program to develop young men for the important jobs which will result from this manufacturing growth.

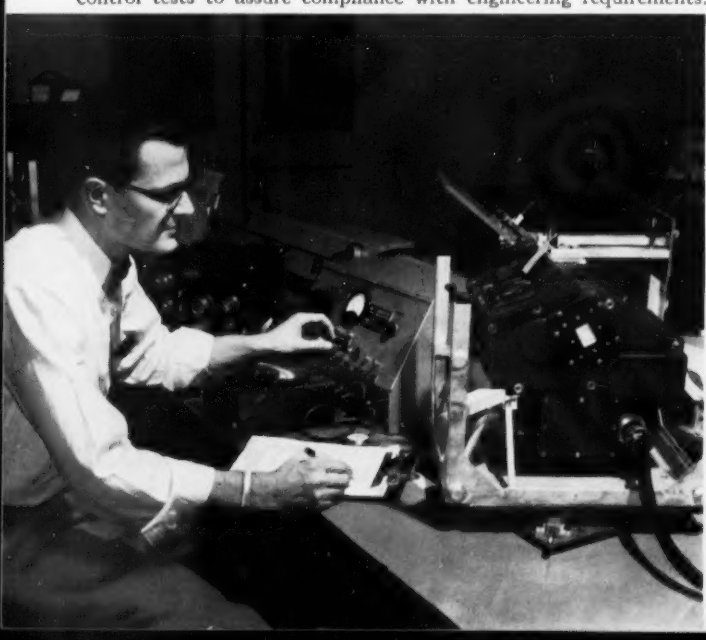
You can share in G.E.'s manufacturing progress. This is a field where manufacturing engineers will apply all their technical knowledge to provide solutions for industry's many problems.

Mechanical, industrial, electrical, and chemical engineers will all find wide opportunities in the varied activities of modern G-E manufacturing. For complete information on careers in manufacturing, write to John E. Jones, Manufacturing Training Program, General Electric Company, Schenectady 5, New York. 957-1

Progress Is Our Most Important Product

GENERAL ELECTRIC

IN QUALITY CONTROL ENGINEERING Chuck Fehlau, Bates College '49, is responsible for devising test procedures and designing test equipment for this jet fighter gun-sighting system. Chuck also audits quality control tests to assure compliance with engineering requirements.



DESIGNING AUTOMATION EQUIPMENT for a new motor production line are these G-E manufacturing engineers. The high engineering content of operations in this manufacturing development laboratory requires the technical skill of outstanding young creative engineers.